T H E S I S

For the degree of Doctor of Medicine

ACUTE ANTERIOR POLIOMYELITIS IN ADULTS.

A Clinical study of the acute stage with reference to differential diagnosis, and treatment with penicillin.

Presented to the
University of Edinburgh

by IAN MURRAY SCOTT,
M.B.,Ch.B. Edinburgh. 1934.

M.D., 1945.

CONTENTS.

	Page
INTRODUCTION.	1
CASE RECORDS.	3
DISCUSSION.	74
THE CLINICAL COURSE.	75
COMPLICATIONS.	105
PROGNOSIS.	107
TREATMENT.	109
CONCLUSIONS.	117
SUMMARY.	119
REFERENCES.	120

INTRODUCTION.

The material for this thesis was obtained while I was working with a Military General Hospital in Sicily. All the cases, except Case 24, occurred while I was in charge of the medical cases at a detachment one hundred miles away from the main Hospital. I am indebted to Lt.-Col. W.L. Ackerman, R.A.M.C., Officer in charge of the Medical Division, for encouragement when he visited the detachment. In the latter part of the epidemic, penicillin was used at the suggestion of Lt.-Col. G.S. Hall, R.A.M.C., Adviser in Neurology, Central Mediterranean Forces, in an attempt to find out whether penicillin was of any value, since the disease is such a lethal one.

I propose to describe sixteen cases of acute Anterior Poliomyelitis and eight other cases, which show points of interest in the differential diagnosis. I shall also mention, briefly, for purposes of comparison, eight other cases of Poliomyelitis which occurred in the other two parts of the hospital during the same period. The clinical aspect only of the disease will be discussed. The epidemiology of the outbreak was investigated by another.

Since the hospital was temporarily split into three sections, certain investigations could not be carried/

carried out: for example, no manometer for the pressure of cerebro spinal fluid was available.

I have been unable to consult much of the literature but I have had access to standard textbooks and to Army publications.

CASE RECORDS.

CASE 1. Lieut. S. aet. 32.

1944, July 17 Onset of headache, feverishness, stiffness and pain in the back of the neck.

18 His Medical Officer found the temperature 100°F. and noticed slight neck rigidity.

19 Patient drowsy and vomited once.

20 He complained of slight diplopia.

21 Admitted to Hospital, complaining of severe pain in the back of his neck and in the right shoulder. On examination, he was drowsy, with temperature 101°F. There was moderate neck rigidity. Kernig's sign positive. All reflexes normal. Diplopia on looking in every direction.

White blood cells - 9,500 per cu.mm. Neutrophil polymorphs 51%, lymphocytes 44%, mononuclears 2%, eosinophil polymorphs 6%. Cerebrospinal fluid clear, not under increased pressure - cells 2,500 per cu.mm. mainly lymphocytes. Protein - a slight increase, Culture sterile, Sugar normal.

22 Temperature 102°F. Disorientated and drowsy, with diplopia on looking in all directions and nystagmus. Paresis of muscles of right shoulder girdle and right arm.

23/

23 Temperature 101.8°F, pulse 68 per minute, respirations varying from 22 - 28 per minute. Disorientated. Abdominal reflexes absent. Cerebrospinal fluid - 1,400 cells per cu.mm. mainly lymphocytes, protein 60 mgms %, culture sterile, sugar normal.

24. Temperature 99.4°F, respirations 32 - 34 per minute. Intermittent delirium. Still complained of diplopia, but no objective strabismus was seen. Slight nystagmus. Diaphragm now paralysed. Intercostal muscles working satisfactorily. No cyanosis.

26 First day of normal temperature. Quieter. Paralysis unchanged. No cyanosis.

31 Had gradually improved. Respiratory rate 24 per minute. Upper abdominal reflexes had returned. Paralysis of right shoulder and arm muscles unaltered.

Aug. 9 Transferred to the Main Hospital, from which received this report:-

Faradic Stimulus -

Right deltoid	No response
Right trapezius, Upper fibres	Very weak response
" " Middle fibres	No response
" " Lower fibres	Very weak response
Right biceps brachialis	Weak response

Other muscles respond, but the triceps is, clinically, markedly affected. Slight diplopia, no nystagmus.

23 Paralysis of right deltoid and biceps. Paresis of right triceps and trapezius. Eye muscles had recovered.

CASE 2. Second Officer S aet 28.

1944.
July 21 Complained of pain in the small of the back and down the left buttock. Temperature taken twice daily by Naval Medical Officer and found normal. No general upset or neck rigidity.

23 Walked into Hospital. Apyrexial. Weakness of left quadriceps and hamstrings. Foot drop of left foot. Tendon reflexes absent in the left leg. No other abnormality found. For administrative reasons, this officer was transferred to the main hospital, where lumbar puncture failed twice.

Aug. 1 I was informed that there had developed weakness of the left infra and supra spinati and of the lateral abdominal muscles.

CASE 3. Marine M aet 26.

1944.
Sept.15 Admitted to Royal Naval Sick Quarters complaining of headache, backache, sore throat, shivering and sweating of twelve hours duration. Temperature 100 F.

16/

16 No signs found to account for the pyrexia. In the evening he had to be assisted on to a bed-pan.

17 Admitted to Hospital. Temperature 102.4°F., pulse 92 per minute, respirations 28 per minute, looked ill. Respirations shallow, with lack of intercostal movement. Breath sounds vesicular, poor air entry. Retention of urine, bladder full. Definite neck rigidity. Kernig's sign slight. No alteration of sensation. No abnormality found in cranial nerves.

Arms - no weakness, reflexes present.

Abdomen - Muscles quite lax, reflexes absent.

Legs - completely paralysed except for weak plantar and dorsiflexion of both feet. All tendon reflexes absent. Babinski's sign doubtful.

White blood cells - 7,100 per cu.mm. Neutrophil polymorphs 73%, Lymphocytes 26%, monocytes 1%. Cerebrospinal fluid clear, not under increased pressure, cells 66 per cu.mm. mainly lymphocytes, protein 180 mgms.%.

18 Temperature 101°F, pulse 80 per minute, respirations 38 per minute. No cyanosis. There was now paralysis of legs, abdomen and intercostal muscles, with the addition of left triceps and forearm muscles. Plantar and dorsiflexion of feet present, plantar reflexes extensor, bilaterally. Required catheterisation twice daily, therefore fluid intake reduced,

21 Temperature 99.6°F, respirations 24 per minute. The condition remained unaltered. There had been no cyanosis. When catheter was passed it was necessary to express the urine by gentle suprapubic pressure. When the pressure was released air was sucked back into the bladder. A few pus cells appeared in the urine for the first time. A course of sulphanilamide was commenced. White blood cells 17,000 per cu.mm. Neutrophil polymorphs 88%.

22 Intercostal muscles were now contracting. Other paralyses unaltered. Urine thick with pus and blood; bladder washed out.

23 Temperature 101°F, pulse rate 110 per minute, respirations 26 per minute. Drowsy and slightly disorientated. Tongue dirty. Bladder could not be emptied because the catheter blocked. Incontinence of faeces. Suprapubic/

Suprapubic cystotomy performed by Capt. Gourevitch, R.A.M.C. under pentothal anaesthesia, total given 0.3 gms. Patient stood the operation well.

24 Paralysis unchanged. Plantar reflexes both extensor.

25 General condition much improved, no pus in urine on naked eye examination.

28 Apyrexial. Paralysis of quadriceps and hamstrings bilaterally and abdominal muscles. Weakness plantar and dorsiflexion of both feet, left biceps brachialis and triceps, and flexors of forearm.
Tendon reflexes absent in left arm and both legs.
Plantar responses still extensor. No control of bladder or anal sphincters.
Urine - pus microscopically.
Culture - staphylococci and coliform organisms,
Finished course of sulphanilamide - 31 gms.

Oct. 6 General condition excellent. Could pass and control urine when suprapubic tube was clipped, and had control of anal sphincter. Ankle reflexes had returned, plantar responses were flexor.

10/

Oct. 10 Passed 10 ounces of urine per urethram at a time, suprapubic tube removed. Still paralysis of abdominal and thigh muscles. Muscles of left arm had almost normal power, reflexes present. Gentle massage and passive movements started.

23 Suprapubic scar firm. Sinus almost closed. Passed 92 ounces of urine per urethram in 24 hours. Urine - a few pus cells microscopically. Transferred to the main hospital.

CASE 4. Lance Corporal C. aet 24.

1944
Sept 9-10 Was in hospital with two days fever, temperature 99°F, headache and epigastric discomfort. Nil abnormal was found and he was discharged.

15 Complained of anorexia.

16 Admitted to hospital with severe headache and lumbar backache. Temperature 100.6°F, pulse 82 per minute. Eyes were injected and pain was felt on moving them. No neck rigidity. White cells 9.800, Neutrophil polymorphs 64%, lymphocytes 34%, monocytes 1%, eosinophil polymorphs 1%.

17 Severe headache and slight neck rigidity. Kernig's sign negative. There was much pain and tenderness in both sacrospinales and/

and glutei, with no weakness. Nil abnormal found on complete examination of the central nervous system.

18 Apyrexial. Less headache, less backache. Right leg weak, mainly quadriceps, hamstrings, glutei and dorsiflexors of foot. Right knee and ankle reflexes absent. Babinski's sign negative.

Cerebrospinal fluid clear, only 1.5 ccs. obtained: cells 110 per cu.mm. (all lymphocytes), protein 150 mgms %, sugar normal, culture sterile. Foot drop prevented by a sandbag.

23 There was considerable pain in right gluteus and hamstrings. Movements of the right gluteus, hamstrings and quadriceps were present but weak. Dorsiflexion of the foot was absent, plantar flexion was weak. Both knee reflexes were now present. Right ankle reflex absent. Fitted with a plaster back-splint to prevent footdrop.

CASE 5. Lieut. F. aet 24.

1944.

During the previous week, he had had a cold in his head.

Nov. 4 While in cinema, noticed headache.

5/

5 He felt severe vertical headache and pain at the back of the neck, becoming worse in the evening. The legs felt weak and painful. During the night he sweated and shivered alternately. Slight lumbar headache and slight pain behind the eyes, worse on moving them. The pain in both thighs and calves was such that he could not find a comfortable position and got out of bed several times.

6 noon Admitted to hospital. Temperature 101.2°F., pulse 100 per minute. Appeared pale but not ill. Tongue furred, bowels had not moved that day. Severe frontal and vertical headache. No abnormality found in the cranial nerves. Abdominal and all tendon reflexes exaggerated. Babinski's sign negative. There was now no muscle pain. Only the left calf was tender. Neck rigidity was slight but definite, with the pain on flexing the head referred to the lower thoracic region. Kernig's sign - the knees could not be straightened; pain was referred only to the back of the thighs.

White blood cells 14,800 per cu.mm. Neutrophil polymorphs 74%, lymphocytes 17% mononuclears 9%.

2 p.m. Cerebrospinal fluid clear, under slightly increased pressure, cells 400 per cu.mm. All lymphocytes, protein 45 mgms %, sugar /

sugar normal, culture sterile.

4 p.m. Very slight weakness of right gluteus and quadriceps group. Right knee jerk diminished, other jerks brisk. Ordered penicillin 15,000 Oxford units I.M.I. 3 hourly.

10 p.m. Increased weakness right thigh and paralysis of bladder.

Lumbar puncture. Cerebrospinal fluid clear, under slight increased pressure, 12 ccs, withdrawn. Cells (lymphocytes) 220 per cu.mm. protein 55 mgms %.

Penicillin 5000 units in 10 ccs, given intrathecally. Catheterised and fluids restricted to 2 pints in 24 hours.

Nov. 7 Temperature 102°F, pulse 104 per minute.

9 a.m. Severe headache and neck rigidity present. Lumbar puncture - Cerebrospinal fluid clear cells. (lymphocytes) 84 per cu.mm. protein 75mgms %.

Penicillin 6,000 units in 12 ccs. given intrathecally.

11 a.m. Paralysis of right leg with drop foot. Left thigh muscles all weak. Right knee reflex absent, other tendon reflexes present but diminished, plantar responses flexor. Abdominal and bladder muscles paralysed, with absent reflexes. Intercostal muscles weak/

weak; diaphragm working well. In the left arm, all movements were present, but were definitely weak; reflexes present. Right arm unaffected. No sensory change. No impairment of cerebration nor involvement of cranial nerves.

9 p.m. White blood cells 11,750 per cu.mm. Neutrophil polymorphs 70%, lymphocytes 20%, mononuclears 10%. Temperature 103.6°F, pulse 96 per minute.

Severe headache, slight backache, slight photophobia, increased neck rigidity with pain still referred to the lower thoracic spine on flexing the head. Kernig's sign present, with some pain referred to the back. Good air entry into lungs.

The right leg was now completely paralysed, flaccid with absent reflexes. Plantar response absent - patient stated it "does not tickle so much as on left side" but no impairment to pinprick or light touch could be made out. The left leg was very weak with only a little power of dorsiflexion of foot. Knee jerk diminished, ankle jerk brisk, plantar response was extensor.

Nov. 7 Left arm showed increased muscle weakness with diminished reflexes. No abnormality in right arm.

Nov. 8/

Nov. 8 Temperature 102.6°F., Pulse 96 per minute.

7 a.m. Respiratory rate rose to 30 per minute after attention to the pressure points. No cyanosis. Intercostal muscles paralysed, diaphragm working well.

10 a.m. Temperature 102.6°F, pulse 104 per minute, respirations 34 per minute. Faint cyanosis. Respiratory excursion and air entry poor. Cerebration unaffected. Placed in a Drinker type respirator. The cyanosis disappeared when he was in the respirator. After one and a half hours, he complained of severe pain at the back of the neck and had to be taken out. An hour later, faint cyanosis occurred and he was put back. By this time he could not swallow even a teaspoonful and was fed by a nasal tube. By the late afternoon cyanosis and distress occurred when he was taken out for nursing attention. He was given continuous oxygen by a Haldane mask. He was quite conscious but had much difficulty in articulating. By 5 p.m. jactitation commenced in the neck muscles. The eyes moved slowly from side to side, with the pupils widely dilated. There was no cyanosis till ten minutes before he died at 7.15 p.m.

The/

The total dosage of penicillin was:-
Intrathecally 11,000 Oxford Units
Intramuscularly 255,000 Oxford Units.

AUTOPSY. The convolutions were slightly flattened and the meningeal veins congested. The upper cervical region of the cord showed diffuse pink staining of the grey matter, not removed by stroking with the knife blade. This was particularly evident in the anterior horn. Microscopically, the spinal cord showed marked congestion, perivascular cuffing with lymphocytes and some small haemorrhages. In the anterior horn there was necrosis and disappearance of some of the nerve cells.
The cerebellum showed only congestion and a few perivascular haemorrhages. In some of the reaction round blood vessels, there were a few polymorphs, but it consisted mainly of small round cells. There was no evidence of damage to nervous cells.

CASE 6. Supply Assistant B Aet. 20.

1944.
Nov. 9 Had a slight attack of shivering, went to bed and felt well.

11 About noon, felt frontal and vertical headache, and pain in the back of the neck. Also noticed a cold in the head. There was no vomiting or backache, no muscle pain or weakness. There was again slight shivering. He arrived as a walking case.

Nov.12 11 a.m. Admitted to Hospital. Temperature 100°F, pulse 110 per minute. Appeared apprehensive and jumpy but not very ill. The conjunctivae were not injected and there was no pain on moving the eyes or pressing the eyeballs. Neck rigidity was present; when the head was lifted, the shoulders also came off the bed. There was very little pain with this, referred to the occiput and the sternum. Kernig's sign very doubtful.

Cranial nerves showed no abnormality, all reflexes were normal and there was no alteration of sensation. Muscle power was found to be normal. In the other systems, no abnormality could be found.

White blood cells - 15,800 per cu.mm. Neutrophil polymorphs 83%, lymphocytes 11%, mononuclears 6%.

Lumbar puncture. Cerebrospinal fluid clear, under slight increased pressure, 12 ccs. withdrawn. Cells 400 per cu.mm., practically all polymorphs, many of them degenerate, making an accurate differential count difficult: protein 95 mgms %, sugar normal, culture sterile. Penicillin, 5,000 units in 10 ccs normal saline was injected intrathecally. 15,000 units were ordered, to be given intramuscularly every 3 hours.

8 p.m./

8 p.m. Temperature 102°F, pulse 122 per minute. Moderately severe headache, with slight photophobia. The only abnormality found was a suspicion of weakness in both recti abdominis, with the lower left abdominal reflex absent. Lumbar puncture. Cerebrospinal fluid faintly opalescent, under increased pressure. Cells 2000 per cu.mm. (100 RBCs, the remainder almost all polymorphs). Direct smear, no meningococci seen, culture sterile. Sugar normal. Proteins (in the supernatant fluid) 120 mgms %. Penicillin 6,000 units in 12 ccs saline was injected intrathecally.

13 6 a.m. There was slight respiratory embarrassment after nursing attention, which improved with rest. The arms were weak, but he brushed his own teeth.

10 a.m. Temperature 102°F, pulse 120 per minute, respirations 34 per minute. Breathing was difficult, with the accessory muscles in use. The intercostal and abdominal muscles were paralysed, with absent reflexes. The diaphragm was moving just enough: there was faint cyanosis. The bladder was distended. The arms were both very weak, the left could just be lifted off the bed, the right could not. All tendon reflexes/

10 a.m. reflexes absent. Plantar responses - flexor. The legs showed all movements weakly present, with tendon reflexes diminished. No sensory loss could be made out. He was catheterised and 32 fluid ounces of urine withdrawn.

11 a.m. Breathing very difficult, with cyanosis. Put in the Drinker type respirator which he tolerated well. There was no cyanosis.

9 p.m. While out of the respirator to have the back attended to, his colour remained good with continuous oxygen till immediately before he was returned into it. Was again catheterised.

14
9 a.m. Temperature 101.8°F, pulse 96 per minute. Complete paralysis of limbs except for slight power in the right quadriceps. Could not swallow; fed by nasal tube. Cerebration good. There was now no respiratory movement when taken out for nursing attention. He asked to go in again.

1.30 p.m. Temperature 102.6°F, pulse 126 per minute. Cyanosed even with respirator working well. Commencing jactitation of jaw muscles. Becoming unconscious.

2.45 p.m. Died.

Total penicillin given:-

By the intrathecal route 11,000 Oxford units.

By the intramuscular route 240,000 " "

AUTOPSY.

AUTOPSY. The brain showed slight congestion and flattening of the convolutions at the vertex, otherwise the only abnormality seen was congestion of the anterior horns in the upper cervical region and medulla oblongata. There was no obvious haemorrhage and no increase in the amount of cerebrospinal fluid. Microscopically, the spinal cord showed congestion, with perivascular cuffs consisting mainly of small round cells. There was degeneration of nerve cells in the anterior horns. The lesions were more pronounced in the cervical region of the cord. In the pons there was congestion and some perivascular cuffing. The cortex showed only congestion.

CASE 7. Leading Stoker H. aet 25.

1944.
Nov. 3 Admitted to this hospital complaining of malaise, shivering, and sweating. Temperature 101.4°F. Apyrexial after 24 hours. No abnormality could be found in central nervous or other systems. He felt well when he left hospital on 8th November.

10 Felt giddiness and frontal headache which passed off after a few hours.

11 Felt intermittent headache.

12/

12 Cold and shivery. During the night he could not get comfortable and was kept awake by pain in his back. He got up to pass urine 3 times. Headache was slight.

13 When examined by a Naval Medical Officer, there was definite tenderness of calf and thigh muscles.

Noon Admitted to hospital. Apyrexial. Looked ill and apprehensive. Conjunctivae not injected. There was slight pain in eyes on looking to the extreme right, none on pressing the eyeballs. There was definite neck rigidity, with pain on flexing the head referred to the lower thoracic spine. Kernig's sign very doubtful. No abnormality found in the cranial nerves. Arms - possibly slight weakness in right triceps muscles, otherwise muscle power good, reflexes present. Abdomen - no weakness, reflexes present. Legs - no muscle weakness. There was by this time no tenderness in calves or thighs. Leg reflexes present except right ankle reflex. Plantar reflexes - flexor. Fauces injected. No cervical adenitis. Other systems - no abnormality found, no tenderness in renal angles. Urine showed no/

no albumen or sugar, and no cells were seen in the deposit.

White blood cells 11,050 per cu.mm. Neutrophil polymorphs 73%, lymphocytes 21%, mononuclears 6%.

Lumbar puncture. Cerebrospinal fluid clear, not under increased pressure; cells 80 per cu.mm (polymorphs 40%), proteins 70 mgms %, sugar normal, culture sterile.

Penicillin 5,000 units in 9 ccs, sterile saline was injected.

Penicillin 15,000 units ordered to be given every 3 hours by intramuscular injection.

13
9 p.m. Temperature 101°F, pulse rate 92 per minute. Slight frontal headaches; the same degree of neck rigidity was still present. There was no alteration in muscle power or in reflexes.

Lumbar puncture Cerebrospinal fluid clear, not under increased pressure. Cells 180 per cu.mm (Polymorphs 30% partly degenerated) proteins 75 mgms %. Penicillin 6,000 units in 12 ccs, sterile saline injected intrathecally.

14 Temperature 101°F, pulse 100 per minute. No tenderness in the muscles, no alteration of/

of sensation. Arms - all reflexes present, slight weakness in the right triceps muscle.

10 a.m. Abdomen - there was a suggestion of weakness in the recti; the patient had difficulty in raising his shoulders from the bed. The right lower abdominal reflex gave a diminished response in comparison with the others. No weakness of lumbar or gluteal muscles. Legs - no muscle weakness, although the right knee and ankle jerks were now absent. Plantar responses - flexor.

Lumbar puncture. Cerebro-spinal fluid faintly opalescent, under increased pressure. Cells 250 per cu.mm. (polymorphs 30%), proteins 60mgms % given intrathecally.

Penicillin 6,000 units in 12 ccs. of sterile saline.

6 p.m. Temperature 101°F, pulse 104 per minute. Little headache, neck rigidity less. Kernig's sign present. Weakness of right triceps, left hamstrings and recti abdominis. Arm and abdominal reflexes present. Of the leg reflexes, only the left ankle jerk was present.

White blood cells 12,200 per cu.mm. neutrophil polymorphs 76%, lymphocytes 15%, mononuclears 9%.

15 Both knee jerks had returned.

16 Apyrexial. The only abnormality that could now be found was slight weakness of the right triceps. All reflexes present.

Penicillin injections were stopped. Total given:-

Intramuscular 360,000 Oxford units.

Intrathecal 17,000 Oxford units.

18 There was still weakness of the right triceps muscle and lack of appetite, but this was slowly improving.

CASE 8. Marine D. aet 18.

1944.

Nov. 13 Remained well till teatime, when he noticed slight headache. By 8 p.m. this was very severe. During the night he felt hot and cold alternately. There was no backache nor muscle pains.

14 When he reported this morning, he was weeping on account of the throbbing headache.

11 a.m. Admitted to hospital. Temperature 99°F, pulse 84, looked ill and apprehensive, complained of severe frontal headache and slight pain on moving the eyes. The neck was stiff, with pain on flexing the head referred to the lower thoracic spine. The chin reached only halfway/

halfway to the chest. Kernig's sign negative. There was no muscle tenderness, no alteration of sensation and no muscle weakness. All reflexes present. No abnormality found in the other systems.

White blood cells 10,900 per cu.mm. neutrophil polymorphs 66%, lymphocytes 23% mononuclears 10%, eosinophils 1%.

Lumbar puncture. Cerebrospinal fluid faintly opalescent, under definitely increased pressure. Cells 480 per cu.m. (polymorphs 45%), proteins 70 mgms % sugar normal, culture sterile. Penicillin 6,000 units in 12 ccs. saline was injected intrathecally, and 15,000 units ordered by intramuscular injection 3 hourly.

9 p.m. Temperature 98.8°F, pulse 68 per minute. Drowsy with moderate headache. The neck rigidity was the same, but with severe pain referred to the lumbar region on flexing the head. Kernig's sign negative. The only abnormality found was diminution of the right triceps jerk with weakness of the muscle and pain when the patient contracted it against resistance.

Lumbar puncture. Cerebrospinal fluid faintly opalescent, under increased pressure. Cells 500 per cu.mm. (Polymorphs 25%), proteins 80 mgms %.

15 Temperature 98.6°F. There was increased weak-
9 a.m. ness in the right triceps and an almost absent reflex. No other muscle weakness or diminution of reflexes. Neck stiffness unaltered. Kernig's sign doubtful.

Lumbar puncture. Cerebrospinal fluid clear, under definitely increased pressure. Cells 300 per cu.mm. (polymorphs 16%), proteins 90 mgms.%.

Penicillin 6,000 units in 12 ccs. given intrathecally.

16 Afebrile. Only abnormality was slight weakness of the right triceps. Total Penicillin given:- Intramuscular 240,000 Oxford units
Intrathecal 18,000 Oxford units.

23 Remained well. The triceps weakness was not evident and the reflex had returned.

CASE 9. Leading Cook L. aet 20.

1944, Nov. 12 Noticed a cold in the head. The bowels moved 3 or 4 times daily for 4 days.

16 Felt nausea, giddiness and sore throat. The bowel looseness had ceased.

18 Admitted to Naval Sick Bay. Temperature 99.4°F., rising to 102°F. with pulse rate 96 per/

per minute in the evening. His throat had the appearance of a streptococcal infection with enlargement of cervical glands. He was given sulphanilamide.

19 Temperature 101°F, in the morning. The throat had improved but the general condition had not. No abnormality could be detected in the central nervous system. In the evening, headache became severe and neck rigidity developed.

8 a.m. Admitted to hospital. Temperature 102°F., pulse rate 88 per minute. Looked pale and ill. Had had 10 grams of sulphanilamide. No conjunctival injection, no pain on moving eyes. The headache was easier, but there was mild photophobia. Neck rigidity was present. When his head was lifted, the shoulders also rose off the bed, but there was remarkably little pain with this: what little there was, was referred to the lumbar region, shoulders and forehead. Kernig's sign was absent. No abnormality was found in the cranial nerves. There was tenderness on squeezing the left calf. All reflexes were present except the right knee jerk which required reinforcement. No weakness of the quadriceps could be made out. Plantar responses were flexor. The tongue was furred and rather dry. The tonsils were large and/

and congested, with a small spot of exudate on the right one. There was moderate bilateral cervical adenitis. A throat swab showed no Vincent's organisms and no Klebs Loeffler Bacilli were grown on culture. No abnormality was found in other systems.

White blood cells 14,550 per cu.mm., neutrophil polymorphs 78%, lymphocytes 13%, mononuclears 9%.

The urine showed no albumen or sugar.

Lumbar puncture. Cerebrospinal fluid faintly opalescent, under slightly increased pressure. Cells 1,580 per cu.mm. (Polymorphs 75%), Proteins 90 mgms % in the supernatant fluid. Another specimen of the fluid formed a spider web clot in 2 hours. Sugar normal. Culture sterile.

Penicillin 6,000 units in 12 ccs, was injected intrathecally and 15,000 units were ordered to be given 3 hourly by intramuscular injection.

20 Temperature 100.4°F., pulse 80 per minute.

9 a.m. Throat less congested, with no exudate. Neck rigidity unaltered. Kernig's sign negative. Both calves tender on pressure. No muscle weakness could be detected. All reflexes were present, but the right knee jerk was diminished.

Lumbar/

Lumbar puncture. Cerebrospinal fluid faintly opalescent not under increased pressure: cells 1520 per cu.mm. (polymorphs 50%), proteins 55 mgms % in the supernatant fluid. Another 6,000 units of penicillin were injected into the theca.

9 p.m. Temperature 100.2°F., pulse rate 70 per minute. Condition unchanged.

Lumbar puncture. Cerebrospinal fluid faintly opalescent, not under increased pressure: cells 1520 per cu.mm. (polymorphs 50%), proteins 55 mgms, in the supernatant fluid. A third intrathecal injection of 6,000 units penicillin was given.

21 Temperature normal. The bowels had not moved since admission. The bladder was distended. The patient felt the urge to empty his bladder, but had been unable to do so since the previous afternoon, although he had previously used a urinal in bed without difficulty. All reflexes were active, including the right knee jerk. No muscle weakness could be detected. The neck was a little less stiff and Kernig's sign was absent. The plantar responses were flexor. There was no alteration of sensation.

White blood cells 14,200 per cu.mm. neutrophil, polymorphs 77%, lymphocytes 14%, mononuclears 9%. The patient was given an enema, with good result; 15 fluid ounces of urine were passed at/

at the same time. The dosage of intramuscular penicillin was reduced to 15,000 units 4 hourly.

22 Temperature 99°F. No headache, little neck stiffness. Passing urine in quantity, 15 or 20 ounces at a time.

23 Apyrexial. Looked and felt well. No headache nor neck stiffness. Complete examination of the central nervous and muscular systems revealed no abnormality.

Blood sedimentation rate (Wintrobe's method) 15 mms, in the first hour.

Penicillin stopped - Total given:-

Intramuscular 390,000 Oxford units.

Intrathecal 18,000 Oxford units.

Dec.12 Did not look quite fit. No muscle weakness; no abnormality found in central nervous system. Red blood cells 4,080,000 per cu.mm. No haemoglobinometer available. Ordered ferrous sulphate 3 grains three times daily.

14 Transferred to Royal Naval Sick Quarters.

CASE 10./

CASE 10. Able Seaman C. aet 22.

1944.

Nov. 13 Had been well till he noticed vague headache for a short while. There were no other symptoms.

14 He noticed stiffness in his buttocks on waking. At 7 p.m. he had an attack of faintness, felt his face hot and then had a shivering attack. There was no headache or backache.

9 p.m. Admitted to hospital. Temperature 98°F, pulse rate 82 per minute. There was a faint suggestion of neck stiffness, the chin just failing to reach the chest. No pain was felt on flexing the head. Kernig's sign negative. The gluteal muscles were tender. There was no muscle weakness nor alteration of sensation. All reflexes were active. A few rhonchi and rales were heard at both lung bases. Urine - No abnormality.

White blood cells 16,150, neutrophil polymorphs 74%, lymphocytes 22%, mononuclears 2%, eosinophil polymorphs 2%.

15 Temperature 97°F, pulse 56 per minute.

8.30 a.m. Complained of stiffness in gluteal and calf muscles, with little tenderness. There was increased neck stiffness, with pain on flexing the head referred to the lower thoracic spine.

Lumbar/

Lumbar puncture was performed in view of the prevailing poliomyelitis.

Cerebrospinal fluid clear, under slight increase of pressure, cells (Lymphocytes) 3 per cu.mm., proteins 30 mgms %.

It was thought that he might be a case of very early poliomyelitis; he was therefore given a course of penicillin by intramuscular injection, 15,000 units every three hours to a total of 250,000 Oxford units.

White blood cells 13,150 per cu.mm.,neutrophil polymorphs 68%, lymphocytes 27%, mononuclears 5%, eosinophil polymorphs 2%.

16 Afebrile. No headache, no neck stiffness, Kernig's sign negative. No abnormality found in the central nervous system, no muscle weakness nor tenderness.

17 Well. White blood cells 14,550 per cu.mm., neutrophil polymorphs 75%, lymphocytes 13%, mononuclears 7%, eosinophil polymorphs 5%. Penicillin course finished.

20 Had remained afebrile and well. When having a bath, the patient had an attack of tachycardia and appeared extremely apprehensive, with widely dilated pupils. No other abnormality was found. No previous history of similar attacks could be elicited.

21 He still appeared unnecessarily apprehensive. In the evening he complained of severe headache.

22 Temperature 100°F, pulse 76 per minute with little variation throughout the day. There was frontal headache and slight stiffness of the neck, not amounting to rigidity. Complete examination revealed no other abnormality. White blood cells 9,050 per cu.mm., polymorphs 72%, lymphocytes 13%, mononuclears 15%.

6 p.m. Severe frontal headache, intermittent in intensity. No discomfort on moving the eyes, Neck stiffness unaltered.

23 Temperature 98.4°F, pulse 60 per minute. Severe frontal headache and increased, but still slight, neck rigidity, with mild pain on flexing the head, referred to the lumbar region. Kernig's sign doubtful, with pain felt only in the back of the thighs. No muscle tenderness or weakness, all reflexes normal, no alteration of sensation.

Lumbar puncture. Cerebrospinal fluid clear, under increased pressure. Cells 100 per cu.mm. (96% lymphocytes), proteins 45 mgms %, sugar normal, culture sterile.

Penicillin, 7500 units in 12 ccs. normal saline, were injected intrathecally.

24/

24 Apyrexial, no headache, no neck stiffness, no paresis, reflexes active,

From this time, the patient remained well. He was no longer apprehensive. There was no recurrence of the tachycardia. Complete examination of the muscular and central nervous systems revealed no abnormality.

Dec. 24 Discharged from Hospital.

CASE 11. Telegraphist G. aet 20.
1944.

Six weeks previously, this patient was treated at R.N. Sick Quarters for clinical Malaria - no parasites had been found. No abnormality had been found on physical examination. The pyrexia, which reached 101.4°F. subsided in 3 days.

Nov.27 Again admitted to R.N. Sick Quarters complaining of nausea, shivering, backache and pain in the limbs.

Temperature 98.6°F. All symptoms subsided within 24 hours and he was discharged on December 1st.

Dec. 2 In the evening he felt occipital headache and slight stiffness at the back of his neck.

3 Admitted to hospital complaining of frontal and occipital headache and stiffness of his neck.

Temperature/

Temperature 99.4°F., pulse 102 per minute. Did not look ill. No injection of conjunctivae, no pain on moving the eyes. There was slight neck rigidity, with pain referred to the occiput on flexing the head. Kernig's sign negative. No abnormality found in cranial or peripheral nerves. No muscle weakness. Tenderness is felt only at the back of the neck. No abnormality in other systems. White blood cells 16,850 per cu.mm., neutrophil polymorphs 81%, lymphocytes 15%, mononuclears 4%.

Temperature 100.4°F., pulse rate 114 per minute, respirations 26 per minute. Slight increase in neck rigidity. There was a suggestion of nystagmus in both directions, otherwise no abnormality in the cranial nerves.

Reflexes. Abdominals present but diminished, biceps, triceps and supinator jerks only faintly present on both sides. Knee jerks much less active than four hours ago, particularly on the right side. Ankle jerks brisk, Babinski's sign negative.

Lumbar puncture. Cerebrospinal fluid clear, not under increased pressure, Cells 1,795 per cu.mm. (polymorphs 60%), proteins 95 mgms %, sugar normal, culture sterile.

Penicillin/

Penicillin 5,000 units in 10 ccs injected into theca.

10 p.m. Temperature 100.8°F., pulse 112 per minute, respirations 36 per minute. Had been vomiting frequently a small quantity of bile stained fluid. Two loose stools passed, also urine, 8 fluid ounces; no abnormality found in it. Ill, toxic, tongue moist and furred, no cyanosis. Marked neck rigidity present, with pain referred to thoracic spine on attempted flexion. Kernig's sign slight. No abnormality in cranial nerves. Abdominal reflexes present. Knee jerks feeble, ankle jerks normal. All tendon reflexes in the arms were feeble, with the left triceps and supinator reflexes absent. The only muscle weakness was the left deltoid. Respiratory movements, though fast, were of ample excursion.

4 9 a.m. Temperature 100.2°F., pulse 108 per minute, respirations 26 per minute. Rational, still vomiting. Neck rigidity well marked. Kernig's sign present. Paralysis of left biceps and deltoid muscle and of left external rectus muscle of the eye.

Lumbar puncture. Cerebrospinal fluid clear, under increased pressure, cells only 82 per cu.mm. proteins 85 mgms %.

Penicillin 5,000 units injected intrathecally.

Noon Temperature/

Noon. Temperature 103.4°F., pulse 100 per minute, respirations 24 per minute. Severe headache, marked photophobia and now weakness of right deltoid muscle. Consciousness was bright and vomiting had ceased.

6 p.m. Face and jaw muscles twitching. Eyes - the right could not be moved out or in, the left could be moved inwards slightly, but not outwards, could not purse lips.

Left arm - paralysis of deltoid, biceps and wrist extensors, other muscles weak.

Right arm - paralysis of deltoid and triceps, other muscles weak,

Abdominal reflexes, knee and ankle jerks had become brisk, plantar responses were flexor. Chest expansion good. Had passed 8 fluid ounces of urine.

Lumbar puncture. Cerebrospinal fluid clear, under slightly increased pressure; cells 305 per cu.mm., proteins 80 gms %.

Given Penicillin 5000 units in 10 ccs. intra-

10 p.m. thecally. Very restless, tired but could not sleep, given luminal gr III by intramuscular injection. Also required morphine gr ¼ and, later, luminal gr.III.

5 Temperature 105°F., pulse 96 per minute,
2 a.m. respirations 32 per minute. Cold sponging had no effect in reducing the temperature. Patient did not feel uncomfortable. Breathing was shallow, but there was no cyanosis and no weakness of the muscles of respiration. Could swallow and speak, but jaw was jerking with each respiration.

6 a.m. Temperature 102.3°F, pulse 96 per minute, respirations 36 per minute. Faint cyanosis without weakness of diaphragm or intercostal muscles. Fully conscious, could speak a little, could not swallow.. Mucus in considerable quantity tended to pass into larynx, foot of bed raised and patient kept on his side. Both arms and the abdominal muscles were paralysed, practically no weakness of legs. Passed urine twice. Given oxygen by nasal catheter and another injection of luminal gr. III.

2.45 p.m. Died.

AUTOPSY. The brain was congested and the convolutions slightly flattened. There was no marked excess of cerebrospinal fluid. On section, there were many small haemorrhages in the cortex and basal nuclei/

nuclei. The cervical and lumbar enlargements of the spinal cord showed marked congestion of the whole grey matter, particularly round the anterior horns.

Microscopic Appearances. The spinal cord showed marked congestion and perivascular cuffing with degeneration and disappearance of nerve cells in the anterior horn. The cortex showed congestion and slight perivascular infiltration, with no abnormality of the nerve cells.

CASE 12. Joiner N. aet 19.
1944.

Three weeks prior to admission, this patient had had a cold in his head.

Dec. 1 Was given inoculations of TAB, tetanus toxoid and typhus vaccine (Cox) at the same time, but in different sites. There was slight local reaction.

4 About tea time he noticed an ache in the small of his back and increasing headache. There was also shivering and nausea. He tossed and turned all night and could not find a comfortable position. He noticed twitching of his limbs, particularly the toes.

5./

5 This morning both thighs were aching.

Noon Admitted to hospital. Temperature 99.6°F., pulse 100 per minute. Did not look ill or abnormally alert; conjunctivae not injected, tongue moist and slightly furred. No pain on moving eyes. There was slight neck rigidity, with pain referred to the lumbar region on flexing the head. Kernig's sign negative. No abnormality found in cranial nerves. Abdominal and tendon reflexes normal. Babinski's sign negative. No muscle weakness. There was slight tenderness of sacrospinalis on both sides. No other abnormality found. White blood cells 10,000 per cu.mm. Neutrophil polymorphs 78%, lymphocytes 17%, mononuclears 5%.

Lumbar puncture. Cerebrospinal fluid clear, ran easily: cells 620 per cu.mm. (60% polymorphs), proteins 75 mgms %, sugar normal, culture sterile. Penicillin 5,000 units in 10 ccs. was injected intrathecally. Ordered Penicillin 15,000 units 3 hourly by intramuscular injection.

6 Temperature 99.6°F, Pulse 84 per minute.

9 a.m. During the night, this patient became restless and complained of severe pain behind his knees, which was relieved by a hot water bottle and phenobarbitone/

phenobarbitone gr II. He passed urine.
There was now increased neck rigidity with pain referred between the shoulders on flexing the head. Kernig's sign negative. Cranial nerves - no abnormality. Arms - brisk reflexes and good muscle power. Abdomen - absent reflexes and marked weakness of the muscles.
Legs - All reflexes diminished, with the right knee jerk almost absent. Babinski's sign negative. There was no muscle tenderness. There was marked weakness of the glutei and hamstrings, particularly on the right side. The glutei, lumbar muscles and leg muscles were not affected.
Lumbar puncture. Cerebrospinal fluid clear and ran freely: cells 406 per cu.mm. (40% polymorphs), proteins 80 mgms %.
Penicillin 5,000 units in 10 ccs. injected.

Noon He passed 12 fl. ozs. urine with difficulty.

6 p.m. Temperature 101.2°F., pulse 120 per minute.
Right leg - reflexes absent, paralysis of quadriceps and hamstrings, weakness of plantar and dorsiflexors of foot.
Left leg - Knee jerk absent, ankle jerk present. Weakness of hamstrings and quadriceps.

7 Temperature 100.6°F, pulse 120 per minute, respirations 22 per minute. Little headache, no/

no backache nor muscle pain. Complete paralysis of abdominal muscles and both legs except for slight movement of plantar and dorsiflexion left foot. Retention of urine, requiring catheterisation twice daily.

8 Temperature 101°F. Pulse rate 110 per minute. Looked and felt better. There was now weakness of deltoid and triceps muscles in both arms, no weakness of respiratory muscles. Intramuscular injections of penicillin reduced to 4 hourly intervals.

9 Temperature 98.4°F, for first time. Abdomen, bladder and legs paralysed. Arm reflexes had all become more active, but there was still marked weakness of left triceps and deltoid, also of flexion and extension of wrist. The left handgrip was 50% of normal. In the right arm there was weakness of the triceps and deltoid.

Intramuscular penicillin stopped - total 450,000 units.

10 Paralysis unaltered, except that he passed urine spontaneously and continued to do so. Intermittently severe pain was felt in the legs, mainly behind the knees, relieved by a hot water bottle and by flexing the knees 10° on a pillow.

14 Still much pain in hamstring muscles. Normal power had returned in right deltoid and triceps muscles, reflexes present. In the left arm there was marked weakness, but not complete paralysis, of the triceps, slight weakness of deltoid, extensors and flexors of wrist: hand grip 80% of normal. The abdominal muscles showed practically no weakness, with reflexes present. In the right leg, there was complete paralysis except for flexion and extension of toes; reflexes absent, plantar response was flexor. In the left leg there was marked weakness, with slight power in quadriceps and dorsiflexors of the foot, toe movements present, reflexes absent, plantar response flexor. Light plaster backsplints were applied, to prevent foot drop.

16 Now no pain. Transferred to R.N. Sick Quarters.

CASE 13 Engine Room Artificer W. aet 22.

1944.

Nov. 28 Admitted to R.N. Sick Quarters complaining of severe frontal headache, "stiffness" of the front of the chest, shivering and sweating at night. His temperature was 100.8°F. No abnormality was found.

The next day, the temperature was normal: he felt well and was discharged on Dec. 1st.

Dec. 4/

Dec. 4 About noon, the patient noticed slight frontal headache, which became severe during the night, accompanied by shivering. In the evening, his shoulders became stiff and he could not bend his head forward. There were no other symptoms. No abnormality was found on examination by the Naval Medical Officer.
During the night, he was kept awake by headache.

5 Admitted to hospital. Temperature 101°F., pulse 108 per minute. Looked ill. Conjunctivae not injected. Tongue moist and furred. No pain on moving the eyes. There was slight neck rigidity, with pain on flexing the head, referred to the lumbar region.
Kernig's sign negative. Otherwise no abnormality could be found.
White blood cells, 14,000 per cu.mm.
Neutrophil polymorphs 80%, lymphocytes 9%, monocytes 11%.

Noon. Lumbar puncture. Cerebrospinal fluid clear and flowed readily. Cells 430 per cu.mm. (polymorphs 50%), Proteins 80 mgms %, sugar normal, culture sterile. Penicillin 5,000 units in 10 ccs. injected. Ordered penicillin 15,000 units 3 hourly by intramuscular injection.

6 p.m./

6 p.m. Temperature 103.8°F., pulse 128 per minute. Severe frontal and occipital headache, not relieved by aspirin. Photophobia. Ordered phenobarbitone gr. II.

6 Temperature 101.2°F, pulse 104 per minute.

9 a.m. The frontal headache was less severe, neck rigidity was increased, with pain referred to the lumbar region. Kernig's sign negative. All reflexes were present, but all feeble. All the muscles had become weaker since the previous day, more than could be accounted for by 48 hours febrile illness. Weakness was evident in both deltoid muscles.

Lumbar puncture. Cerebrospinal fluid clear, ran freely: cells 380 per cu.mm. (50% polymorphs), proteins 70 mgms %. Given penicillin 5,000 units in 10 ccs, intrathecally,

9 p.m. Temperature 102.8°F., pulse 102 per minute.

Lumbar puncture. Cerebrospinal fluid clear, under slight increase of pressure: cells 180 per cu.mm. (30% polymorphs), proteins 60 mgms%. Given a third intrathecal injection of 5,000 units penicillin.

7 Temperature 100.4°F. Felt improved. No headache but neck rigidity and Kernig's sign were present.

No/

No abnormality found in leg or abdominal muscles. No weakness of respiratory muscles. In the left arms there was weakness of deltoid, triceps and dorsiflexor muscles of wrist, with absent triceps jerk. The biceps and supinator reflexes were diminished. In the right arm, there was weakness of the deltoid muscle. Tendon reflexes present but diminished.

8 Temperature normal for first time. Penicillin discontinued, total given - 400,000 Oxford units. The paralysis remained the same but there was, in addition, retention of urine. A catheter was passed by Surgeon Lieutenant Beach, R.N.V.R.

9 Very much improved. Managed to pass urine. The only abnormality now found was considerable weakness of the left triceps muscle.

11 Power in the right triceps muscle was normal.

13 Pyrexia, malaise, and frequency of micturition appeared, with pus in the urine, from which a heavy growth of coliform organisms was obtained on culture.

19 Very well. Urine sterile after a course of sulphanilamide 25 grams.

No paralysis or weakness remained.

CASE 14./

CASE 14. Sub Lieut. A. aet 24.

Eight days previously, this officer was given TAB, tetanus toxoid and typhus (Cox) inoculations. For 36 hours he noticed shivering, headache and malaise, then gradually improved.

Dec. 6 This morning, the patient noticed slight stiffness in his shoulders. This afternoon there was difficulty in bending his back. There was gradual onset of headache, which became very severe across the forehead and at the occiput, felt also down the back. He could not find a comfortable position. There was slight shivering and slight pain on moving the eyes.

10 p.m. Admitted to hospital.
Temperature 100°F., pulse 90 per minute. Very restless and apprehensive, but did not look ill. No conjunctival injection, slight pain on moving eyes. Tongue moist and furred. Very severe backache and neck stiffness, with pain on flexing the head referred to the lumbar region. Kernig's sign positive. No other abnormality found in the central nervous system, no muscle weakness or tenderness. Apart from a faint blotchy rash on the/

the chest, other systems were normal. White blood cells 9,450 per cu.mm., neutrophil polymorphs 73%, lymphocytes 11%, monocytes 14%, eosinophil polymorphs 2%.

Lumbar puncture. Cerebro-spinal fluid not under increased pressure, clear. Cells 1,050 per cu.mm. (60% polymorphs), proteins 110 mgms %, sugar normal, culture sterile. Penicillin 5,000 units in 10 ccs. was injected intrathecally. Penicillin 15,000 units by intramuscular injection ordered 3 hourly.

7 Was very restless during the night and given luminal gr. I on two occasions. Temperature 100.2°F., pulse 100 per minute. Very severe lumbar pain, muscles not tender; neck rigidity and Kernig's sign much increased. All the reflexes were brisk; no clonus, no alteration of sensation. Given morphine gr ¼.

10 a.m. Lumbar puncture. Cerebrospinal fluid clear, not under increased pressure: cells 265 per cu.mm. (25% polymorphs), proteins 110 mgms %. Given intrathecal injection of penicillin 5,000 units. Redness of the skin over the buttocks and shoulders had already appeared in spite of nursing case.

Noon. Had no headache, but complained of severe lumbar/

lumbar pain which required another injection of morphine.

6 p.m. Still neck rigidity. Pain in back had become easier. The skin was more red over the buttocks and shoulders, also over the site of lumbar puncture, the size of the swab and the adhesive strapping. The remainder of the area painted with iodine was not involved.

Dec.8 Temperature 100°F, pulse 120 per minute. Backache less. During the night, paralysis had appeared in both legs, except plantar and dorsiflexor muscles of feet and in abdominal, bladder and intercostal muscles. The diaphragm was working well, no cyanosis.

11.30 a.m. Patient distressed, breathing shallow, with faint cyanosis. Cerebration good. Put in a Drinker type respirator which restored his colour to normal. He tolerated it well. Injections of penicillin were stopped - total given 180,000 Oxford units.
During the day, he was taken out of the respirator twice for nursing attention and catheterisation. While he was out, there was slight respiratory movement. Cyanosis was prevented by oxygen given continuously by mask. Weakness appeared in the muscles of both shoulder girdles.

9 Colour fairly good in respirator, much mucus in the throat; the respirator cabinet had to be tilted. Complete paralysis of all limbs except that hands could be moved a little. Paralysis of abdominal and respiratory muscles. Fully conscious, could talk a little but could not swallow. Nasal catheter passed.
Eye movements were satisfactory and he could move his head from side to side.
The mucus in the throat was partly controlled by injections of atropine gr. $\frac{1}{100}$.
Luminal was given as necessary.

10 Colour good but there was much mucus secretion. Temperature 103°F. Pulse varying from 120 to 160 per minute and of poor volume.
By the afternoon there was marked oedema of the lungs and a blotchy rash on the chest was obvious.

11 Slept four hours during the night. Conscious, with full eye movements, but could not speak. Died in the afternoon.

Autopsy. The brain showed slight congestion and flattening of the convolutions. There was no increase in quantity of the cerebrospinal fluid. There was congestion of the anterior horns of the spinal cord with one or two very small haemorrhages in the upper cervical region and in the basal nuclei.

Microscopic/

Microscopic appearances. The cortex showed only congestion. In the basal nuclei, there was marked infiltration with small round cells and a few polymorphs, particularly round the vessels. A few small haemorrhages were seen. In the cervical cord, there was congestion, particularly of the anterior horns, with perivascular infiltration. Nerve cells were seen to be degenerated.

CASE 15. Seaman C. aet 20.

Three months previously, this patient had had an attack of bacillary dysentery.

Dec. 1 He was given inoculations of TAB, tetanus toxoid and typhus (Cox) vaccine.

2 Diarrhoea, 4 or 5 times a day, commenced. No blood or mucus was noticed.

3 Started to have frontal headache and pain in the back and legs.

6 Admitted to hospital. Temperature 103.6°F., pulse 96 per minute. Tongue rather dry and slightly furred. There was slight tenderness over the colon. There was no abnormality in the lungs. Slight neck stiffness was noticed, with some pain referred between the shoulders on flexing the head. Slight photophobia was complained of and there was a little pain on moving/

moving the eyes and on pressing the eyeballs. Kernig's sign negative. Reflexes were diminished. Babinski's sign negative. No muscle weakness could be made out, but the patient felt weak when he tried to turn in bed.
White blood cells 10,750 per cu.mm. Neutrophil polymorphs 72%, lymphocytes 23%, monocytes 5%. The patient, shortly after admission, passed two liquid brown stools, without mucus. Microscopically, a few red blood cells and pus cells were seen.
Sulphaguanidine 6 grams to be followed by 3 grams every 4 hours, was ordered. The patient later vomited twice.

7 No more vomiting or diarrhoea. Slept badly on account of severe lumbar backache. There was increased neck stiffness. Kernig's sign negative. Arm reflexes were brisk, and leg reflexes diminished. There was then no pain in legs, no muscle tenderness or weakness. The abdomen was slightly distended, with the caecum gurgling.

Noon. In view of the prevalence of poliomyelitis, lumbar puncture was performed.
Cerebrospinal fluid clear, not under increased pressure, cells 4 per cu.mm., protein 20 mgms%. Penicillin 3,500 units in 7 ccs. of sterile normal saline was injected intrathecally.

Ordered/

Ordered penicillin 15,000 units 3 hourly by intramuscular injection. Sulphaguanidine stopped.

4 p.m. Temperature 102.6°F. Commencing headache.

6 p.m. Temperature 104.6°F., pulse rate 88 per minute. Very severe occipital headache, neck rigidity and tenderness of neck muscles. Had vomited twice. No muscle weakness or other abnormality in the central nervous system could be found. Given morphine gr, ¼.

Lumbar puncture. Cerebrospinal fluid opalescent, drops were infrequent, and only 2 ccs. could be obtained. Cells 550 per cu.mm (70% polymorphs) culture sterile. A spiderweb clot formed within 2 hours. Sugar normal.

In view of the possibility that infection had been introduced into the theca, sulphadiazine was ordered to be given orally, 3 grams, then 2 grams, followed by 1 gram at 4 hourly intervals with ample fluids and sodium citrate 30 grains with each dose.

8 Temperature 104°F. 5 blood-slides showed no malaria parasites. Had vomited copiously twice, but was keeping down small quantities of fluids. Cerebration good. Neck rigidity slightly less, but there was still pain and tenderness/

tenderness in the neck muscles. No abnormality found in lungs, abdomen or cranial nerves. Arm reflexes were diminished. Abdominal and leg reflexes were absent: plantar responses were flexor. There was slight weakness of quadriceps and hamstring muscles bilaterally, and tenderness in the left calf.

White blood cells 9,300. Neutrophil polymorphs 70%, lymphocytes 19%, mononuclears 11%.

Blood culture sterile after 4 days.

9 Temperature 102°F., pulse 92 per minute. Drowsy. Tongue moist. Still had marked neck rigidity and Kernig's sign positive.

Arm and leg reflexes present but much diminished, plantar responses flexor, abdominal reflexes absent. There was no muscle paralysis but all movements were weak.

In view of the vomiting, sulphapyridine soluble 3 grams by intramuscular injection was ordered to be given as well as the penicillin.

White blood cells 9,400 per cu.mm. Neutrophil polymorphs 78%, lymphocytes 11%, monocytes 11%.

10 Temperature 101.4°F., pulse rate 80 per minute. A little improved. Headache much less.

Lumbar puncture. Cerebrospinal fluid clear, not under increased pressure. Only 2 ccs, obtained/

obtained. Cells 150 per cu.mm. (30% polymorphs), proteins 55 mgms %, culture sterile.

11 Temperature 99°F. He looked and felt much improved. Little neck rigidity. Kernig's sign negative. All reflexes diminished, but present. No vomiting. No paralysis. Sulphapyridine soluble injections stopped, total 15 grams. Penicillin injections stopped, total 480,000 units. Continued to have sulphadiazine 1 gram 4 hourly.

For the next six days, evening pyrexia of 100°F. continued, with frequency of micturition. The urine contained many pus and epithelial cells. Coliform organisms were cultured.

17 Afebrile. Well. Urine sterile. No abnormality could be found. Sulphadiazine stopped - total 21 grams,

Transferred to R.N. Sick Quarters.

CASE 16. Sub-Lieut. B. aet 23.

Dec. 9 Patient felt lumbar backache.

10. Also felt temporal and occipital headache. During the night, the headache and backache were so severe that he could not sleep.

11 Started shivering. There had been no muscle pain and no recent febrile illness, nor diarrhoea.

4 p.m./

4 p.m. Admitted to hospital. Temperature 98°, pulse rate 96 per minute. Did not look ill. Eyes not injected, no pain on moving them. By then, headache was slight and backache moderate. Neck rigidity slight but definite, with pain referred to the lumbar region when the head was flexed. No other abnormality found on physical examination. Tendon reflexes sluggish,

White blood cells 15,050 per cu.mm. Neutrophil polymorphs 88%, lymphocytes 5%, mononuclears 7%.

6 p.m. Temperature had risen to 102.4°F, pulse rate 120 per minute, and headache had become severe. Lumbar puncture. Cerebrospinal fluid clear, ran easily. Cells 550 per cu.mm. (65% polymorphs), proteins 65 mgms %, sugar normal, culture sterile.

Penicillin 5,000 units in 10 ccs, given intrathecally and 15,000 units ordered intramuscularly every 3 hours.

12 Temperature 103°F., pulse 120 per minute.

9 a.m. Had severe occipital headache during the night. Neck rigidity increased. Kernig's sign negative. The only abnormalities found were weakness of the left deltoid muscle and absence/

absence of the left triceps reflex.

Lumbar puncture. Cerebrospinal fluid clear and ran freely, cells 760 per cu.mm. (60% polymorphs), proteins 80 mgms %.

Given penicillin 5,000 units intrathecally.

2 p.m. Temperature 102.6°F., pulse 108 per minute. There was now evident weakness of left triceps and biceps muscles in addition to the deltoid muscle, with absent reflexes.

13 Temperature 101°F., pulse 86 per minute. Little headache, lumbar backache present. No further paralysis.

15 Temperature 99°F. Paralysis unaltered. The left arm was fixed to the head of the bed with a sling, to avoid overstretching of the deltoid muscle. The injections of penicillin were given at 4 hourly intervals.

16 Apyrexial. Penicillin stopped, total 455,000 units. There was still slight neck rigidity. Little headache. Legs, abdomen and right arm normal.

In the left arm, the biceps and supinator reflexes were weak, the triceps reflex was absent. The triceps and deltoid muscles could be moved, but not against pressure.

The patient could move his arm to the horisontal but could not keep it there.

18 Neck rigidity had disappeared.

26 The only abnormality was the weakness of the left triceps and deltoid muscles. An "aeroplane" splint was fitted and he was transferred to the main hospital.

CASE 17. Lieut. B. aet 22.

One week prior to the onset, this patient had a cold in his head.

Dec. 1 In the morning, he noticed slight frontal headache which became progressively worse. At 2 p.m. he had a mild shivering attack. At 4 p.m. he was given inoculations of TAB, tetanus toxoid and typhus (Cox) vaccines, not having mentioned his symptoms. By the evening, he had severe frontal and occipital headache, and pain in legs and lumbar region.

9 p.m. Admitted to hospital. Temperature 103°F., pulse rate 108 per minute. Eyes slightly injected, with pain on looking to the extreme right and left. Did not look ill. Tongue coated. There was no neck rigidity, but slight pain was felt on flexing the head, referred to the lower thoracic region. Kernig's sign negative. There was definite tenderness of the sacrospinalis and posterior neck muscles and slight tenderness of the hamstring/

hamstring muscles. No abnormality could be found in the central nervous or other systems. White blood cells 9,250 per cu.mm., neutrophil polymorphs 82%, lymphocytes 10%, mononuclears 8%.

2 Temperature 101.2°F., pulse 96 per minute. Headache less severe, but increased neck stiffness; the head could not be flexed as far as it could be the previous night. Hamstring and sacrospinalis muscles tender. Slight photophobia.

Lumbar puncture. Cerebrospinal fluid clear, and flowed freely, cells 8 per cu.mm. (all lymphocytes), proteins 30 mgms %.

Penicillin 6,000 units in 12 ccs, was injected intrathecally. The reason for doing this is discussed later.

Penicillin 15,000 units intramuscularly was ordered to be given 3 hourly.

3 Temperature 99.6°F., pulse 74 per minute. Much improved. Less rigidity of neck. No muscle tenderness or weakness. No abnormality found in central nervous system.

4 Apyrexial. No abnormality found.

Penicillin discontinued - total 155,000 units

Remained well.

12 The symptoms and signs of infective hepatitis appeared. This developed into an attack of moderate severity.

CASE 18. Sub-Lieut. E. aet 19.

For the previous 3 weeks, this patient had a cold in his head.

Nov. 28 He was given inoculations of TAB, tetanus toxoid and typhus vaccines, and felt well after this.

30 Noticed headache and dizziness. There was no pain or swelling at the sites of inoculation.

Dec. 1 Very severe frontal and temporal headache developed. He vomited once and noticed diplopia which lasted 1½ hours.

11 a.m. Admitted to hospital. Temperature 100°F., pulse 80 per minute. Was abnormally alert and jumpy but did not look ill. No injection of conjunctivae: no pain on moving the eyes. No neck rigidity: Kernig's sign negative. There was now no diplopia: no abnormality of eye movement could be detected. Pupils were equal and reacted to light and accommodation. No abnormality found in central nervous or other systems. No muscle tenderness. White blood cells 9,900 per cu.mm. Neutrophil polymorphs 83%, lymphocytes 14%, mononuclears 3%.

4 p.m. Temperature 101.6°F. Headache severe. Diplopia in all fields had recurred; objectively/

objectively there was slight internal strabismus of the right eye. No other abnormality found.

Lumbar puncture. C.S.F. clear, not under increased pressure. Cells 30 per cu.mm. (30% polymorphs), proteins 50 mgms %, sugar normal, culture sterile.

10 p.m. Headache less severe. Vomited twice.
Ordered penicillin 15,000 units intramuscularly 3 hourly.

2 Temperature 104.6°F., pulse 100 per minute. Did not feel hot, but headache was troublesome. Slight diplopia. The patient was alternately anxious and drowsy. Occasional twitchings of face occurred.
White blood cells 13,400 per cu.mm. Neutrophil polymorphs 78%, lymphocytes 15%, mononuclears 7%.
During the day, there were marked variations in temperature - from 104°F. to 99.8°F. within 2 hours and then rising two hours later to 103°F.

3 Temperature 100.6°F., pulse 86 per minute. Was very restless during the night, and complained of nausea.
Mentally bright and co-operative. Slight diplopia/

diplopia with central vision; no sign of any other abnormality in the central nervous system, or other systems of the body.
White blood cells 14,200. Neutrophil polymorphs 70%, lymphocytes 19%, mononuclears 11%.

4 Temperature 99°F. Much improved, no diplopia. Injections of penicillin ceased, total 300,000 units. Ordered phenobarbitone gr. I twice daily.

5 Apyrexial. Complained of a dull ache over sacrum radiating to front of thighs, not made worse by movement. No neck rigidity, but extreme flexion of the head caused pain in the lower back.
Reflexes brisk, no muscle weakness, no alteration of sensation.

6 Temperature 101°F., pulse 98 per minute. His mind tended to wander: there was slight loss of memory for recent events. He spilt his cup when drinking: no objective evidence of incoordination could be found. Neck rigidity a little more definite, with Kernig's sign present. The backache had improved.
He tended to slur his words.
Later in the day, retention of urine necessitated catheterisation, the simpler aids to urination having failed. Administration of luminal stopped. Ordered sodium bromide gr. XX twice daily.

7 Temperature 99°F. Had slept well. Passed urine satisfactorily, having required catheterisation only once. No abnormality found.

8 Temperature 100.4°F. Continuous diplopia had recurred. He vomited after every meal. Bowels moved well, twice. There was still slight neck rigidity and slight Kernig's sign. No other abnormality of cranial nerves. Tendon reflexes diminished, particularly in the right leg. Plantar responses remained flexor.
White blood cells 15,400 per cu.mm. Neutrophil polymorphs 75%, lymphocytes 13%, mononuclears 12%.

9 Complained of slight dysuria, felt at the end of the act of micturition. The only abnormality found was an absent right knee jerk. The urine showed many pus cells and culture showed 4 colonies of staphylococci after 48 hours. Ordered sodium citrate gr. XXX and sodium bicarbonate gr.XX five times daily.

14 Temperature 101°F. There had been no neck rigidity and no diplopia for 5 days. The only symptoms were of the urinary infection. He looked better. Examination of the urine showed pus cells and culture revealed coliform organisms. Ordered sulphanilamide 2 grams, then 1 gram 4 hourly.

21 Afebrile, well. The urine was sterile and contained no pus cells after a course of 30 grams sulphanilamide. Central nervous system normal. No muscle weakness demonstrable.

CASE 19. Able seaman F. aet. 21.

Nov. 28 The patient was given inoculations of TAB, tetanus toxoid and typhus (Cox) vaccines.

29 He complained of pain in the back of the head and neck. He felt shivery and nauseated. There was little local reaction in either arm.

Dec. 1 The occipital headache had continued, and became more severe. He felt his legs so weak that he could hardly stand. There was slight photophobia. No muscle pain was felt.

11 a.m. Admitted to hospital. Temperature 103°F., pulse rate 112 per minute. Did not look ill but was excitable. No injection of conjunctivae, no pain on moving the eyes. There was occipital and vertical headache, with tenderness of the posterior neck muscles. Neck rigidity was absent, but pain on extreme flexion of the head was felt in the lower thoracic region. Kernig's sign absent. The pupils were equal, reacting to light and accommodation. Tendon reflexes were very brisk with Babinski's sign and clonus absent. In the/

the lungs, numerous high pitched rhonchi were heard. No other abnormality was present. White blood cells 14,050 per cu.mm. Neutrophil polymorphs 80%, lymphocytes 15%, mononuclears 4%, eosinophil polymorphs 1%.

5 p.m. Temperature 101°F., pulse rate 104 per minute. Headache was a little less, but the neck was rigid. Little discomfort was felt when the head was flexed. Kernig's sign negative. Reflexes brisk. No muscle weakness.

Lumbar puncture. Cerebrospinal fluid clear, not under increased pressure. Cells 300 per cu.mm., (60% polymorphs), proteins 60 mgms %, sugar normal, culture sterile.

2 Temperature 103°F., pulse 104 per minute. Drowsy but jumped up suddenly when disturbed. Slight neck rigidity present, with Kernig's sign also. Complained of transient diplopia. There was nystagmus on looking to the right. Reflexes extremely brisk, no clonus, Babinski's sign absent.

White blood cells 14,300 per minute; neutrophil polymorphs 82%, lymphocytes 11%, mononuclears 7%.

4 Afebrile, much improved. No headache, no diplopia. Apart from very slight neck rigidity, there was no abnormality. Phenobarbitone gr.I twice/

twice daily was ordered and the patient was kept very quiet.

14 The patient had remained well and was allowed up. Transferred to Royal Naval Sick Quarters.

CASE 20. Signalman K. aet 19.

1944.
Oct. 1 Admitted to hospital. He complained of sudden onset, in the morning, of severe frontal headache and vomited several times.
On examination, the temperature was 100°F., pulse 60 per minute. The face was flushed, with circum-oral pallor and the conjunctivae were injected. Pain was felt on moving the eyes. On the front and back of the chest, and on the upper arms were a few macules: no rash on face. Tongue moist, lightly coated.
2 spots of exudate on the right tonsil which was slightly inflamed. There was definite neck rigidity but Kernig's sign was negative. Marked photophobia was complained of. The spleen could just be felt, as were a few small discrete lymph glands in neck, axillae and groins. No abnormality could be found in the central nervous system. No malaria parasites seen in 4 blood films.
White blood cells 6,800 per cu.mm. Neutrophil polymorphs/

polymorphs 80%, lymphocytes 13%, monocytes 5%, eosinophil polymorphs 2%.

Lumbar puncture. Cerebrospinal fluid clear, ran freely. Cells 60 per cu.mm. (88% lymphocytes), Proteins 50 mgms%.

3 The pyrexia and rash lasted only 24 hours. There was still slight neck rigidity: no other neurological sign.

White blood cells 4,800 per cu.mm. Neutrophil polymorphs 58%, lymphocytes 39%, monocytes 3%.

6 Very well. Still a few lymph glands palpable in neck, axillae and groins. Spleen just palpable.

White blood cells 7,150 per cu.mm. Neutrophil polymorphs 72%, lymphocytes 25%, monocytes 3%.

10 Well. There was no residual headache or depression.

CASE 21. Leading seaman N. aet. 21.

1944.

Oct. 3 Admitted to hospital complaining of sudden onset, at 1 a.m., of severe frontal headache and inability to move the eyes on account of the pain on movement. Patient also noticed his neck becoming stiffer.

Temperature 102°F., pulse 88 per minute. Neck rigidity and photophobia were present. Kernig's/

Kernig's sign negative. No other abnormality. White blood cells 10,250 per cu.mm: neutrophil polymorphs 79%, lymphocytes 19%,monocytes 2%.

Lumbar puncture. Cerebrospinal fluid clear and ran freely. Cells (all lymphocytes) 350 per cu.mm. Proteins 25 mgms %.

4 Temperature 100.4°F., pulse 76 per minute. Improving. White blood cells 9,900 per cu.mm. Neutrophil polymorphs 75%, lymphocytes 22%, monocytes 3%.

5 Temperature normal. No abnormal symptoms or signs.

6 White blood cells 7,750 per cu.mm. Neutrophil polymorphs 63%, lymphocytes 33%, monocytes 1%, eosinophil polymorphs 3%.
Patient remained well, with no headache and little depression.

CASE 22. Marine H. aet 23.
1944.
Oct.12 In the early morning, there was sudden onset of severe frontal headache, coryza and a rigor, with slight pain on moving the eyes.
Temperature 102.4°F., pulse rate 100 per minute. There was neck stiffness, with pain on flexion of the head referred to the epigastrium.
There was then practically no pain on moving the/

the eyes. Coryza and a few high pitched rhonchi in the lungs were also found. In the evening the temperature rose to 104°F.

13 Temperature 102°F, pulse 90 per minute. There was increased headache and neck stiffness. Kernig's sign negative. There was slight tenderness of sacro-spinalis muscles bilaterally.

Lumbar puncture. Cerebrospinal fluid clear and dripped freely. Cells 150 per cu.mm. (all lymphocytes), proteins 55 mgms %.

White blood cells 9,250 per cu.mm. Neutrophil polymorphs 82%, lymphocytes 5%, monocytes 13%.

14 Temperature 102°F., pulse rate 88 per minute. Headache had recurred, after relief by the lumbar puncture. Neck rigidity less, Kernig's sign negative. Very few rhonchi in lungs. No lymphadenitis or splenomegaly.

White blood cells 9,600 per cu.mm. Neutrophil polymorphs 70%, lymphocytes 16%, monocytes 14%.

15 Temperature 100°F. falling by lysis.

White blood cells 7,750 per cu.mm. Neutrophil polymorphs 48%, lymphocytes 34%, monocytes 16%, eosinophil polymorphs 2%.

16 Temperature normal. Apart from lassitude, there was no abnormality.

Within one week, the patient felt well.

CASE 23./

CASE 23. Leading Aircraftman P. aet 23.

1944.
Aug. 28 Complained of mild sore throat of twenty-four hours duration.
Temperature 100°F. Slight congestion of tonsils, with follicular exudate on the right side. No adenitis.

29 Throat swab report: "Organisms morphologically indistinguishable from the Klebs Loeffler bacillus". Given intramuscular injection of 24,000 units diphtheria antitoxic serum (concentrated - 4,000 units per cc.)

30 Temperature 99°F. Fauces mildly injected, without exudate. A second dose of 24,000 units serum given.

Sep. 2 Was very well, with normal temperature for two days. Then he felt extremely severe pain and tenderness over the third and fourth lumbar vertebrae and sacrospinalis muscles, more marked on the left side. Although the patient had been given morphine gr. ¼, he took the cover off the hot water bottle and placed it over his lumbar region, causing a second degree burn.

3 Temperature 100,4°F., pulse 78 per minute. Pain less, but slept badly. Complained of difficulty in passing urine.

4./

4 Temperature 100·4°F. Now no pain, but paraplegia had developed. All leg muscles weak. Of the tendon reflexes, only the right ankle reflex was present. Plantar responses absent. Patient complained of slight paraesthesia in the legs generally. In a small area below the left internal malleolus, there was blunting of sensation to light touch, heat and cold. Abdominal muscles weak, lower abdominal reflexes absent. The bladder was distended and required catheterisation. Urine normal.

5 Paralysis of abdominal and leg muscles, with all reflexes absent. Slight general numbness in the legs. No anaesthesia. Tenderness on squeezing the calf muscles. Bilateral extensor plantar response.

White blood cells 15,000 per cu.mm. Neutrophil polymorphs 60%, lymphocytes 26%, monocytes 10%, eosinophil polymorphs 2%, basophil polymorphs 2%.

Lumbar puncture. Cerebrospinal clear, not under increased pressure. Cells 24 per cu.mm. (all lymphocytes), proteins 25 mgms %.

Blood Kahn test negative.

Catheterisation continued twice daily.

7 Temperature 101°F., pulse 76. Slight improvement in plantar and dorsiflexion of left foot. Carbachol 1 cc. failed to cause contraction of the/

the bladder. Sensation objectively normal in abdomen and legs.

White blood cells 15,800 per cu.mm. Neutrophil polymorphs 80%.

9 Temperature normal. 2 injections of carbachol, 1 cc, at an interval of three hours caused a desire to micturate, amounting to pain, but no urine was passed. Microscopy of a catheter specimen of urine revealed no pus cells.

Sodium acid phosphate 20 grains three times daily was ordered. Plantar responses still extensor.

11 Power of all the affected muscles was returning to a slight extent. 3 abdominal reflexes, and both knee jerks were present. The right ankle jerk was brisk, the left absent. Plantar responses were doubtful. The patient felt a desire to micturate but could not manage it.

Lungs normal. Urine normal.

White blood cells 12,000 per cu.mm. Neutrophil polymorphs 71%.

13 Legs "felt less numb". For the first time, pus cells were found in the urine. Sulphanilamide 2 grams, then 1 gram every 4 hours, with sodium citrate 30 grains was ordered to be given every 4 hours.

14 Temperature 99°F. Managed to pass urine naturally,/

naturally, 2 to 8 fluid ounces at a time.
Fluid intake increased.

15 Passed 6 pints of urine in 24 hours. Less pus in the urine.

19 Urine clear of pus. Course of sulphanilamide finished, total 26 grams.
In the right leg, all movements were present, with weak quadriceps muscles.
In the left leg, movements were slight but improving, the quadriceps and hamstring muscles being particularly weak. All reflexes were present. The plantar responses were still extensor.

Oct.14 The reflexes were now brisk, with slight ankle clonus. Muscle power was improved, with the left leg still the weaker.
Patient was transferred to the main hospital.

Nov.20 I was informed that, by this time, muscle paralysis was limited to the left thigh, in which it was such that he could not control the mobility of the knee for weight-bearing.

CASE 24./

CASE 24. Private T. aet 19.

1944.

Feb. 28 The patient complained of sure throat of 24 hours duration.

29 Since there was a suggestion of a membrane, diphtheria antitoxic serum 24,000 units was given. The serum was concentrated (4,000 units per cc.)

Mar. 1 24,000 units of serum was repeated. The Klebs-Loeffler bacillus was not grown on culture. The throat was clear by this time, and the patient was very well.

6 Evening temperature was 102°F. During the night the patient had severe headache, neck rigidity and Kernig's sign was positive, with extensor plantar responses.

Lumbar puncture. Cerebrospinal fluid clear, under slight increase of pressure: cells 42 per cu.mm. (96% polymorphs), proteins 40 mgm %, chlorides 725 mgms %.

7 An urticarial rash appeared on face, trunk and limbs, with the knees, wrists and right shoulder swollen and painful.

8 Headache gone.

13 First day without fever. All symptoms had disappeared and the patient made an uneventful recovery.

DISCUSSION.

Price (1934) defines acute anterior Poliomyelitis as an acute febrile disease, occurring sporadically and sometimes in epidemics, which is incident chiefly upon children though no age is exempt. It is due to infection of the nervous system, via nerve terminals and axons, with a virus which can be cultivated and which, when inoculated into monkeys, reproduces the disease and can be recovered from the nervous system. The clinical aspect is that of a short, acute febrile illness, often with signs of meningeal irritation,followed by symptoms indicative of damage to the central nervous system. The lesion of the spinal cord produces atrophic paralysis.

All the cases in my series were fit men, mainly from a Naval Base. Their ages varies from 18 to 32, with an average age of 23. Although the disease is commonest between the ages of 2 and 4, cases in early adult life are "common enough" (Price 1934). Three cases in this series were over the age of 25. Russell Brain (1942) states that cases are very rare after that age.

Nothing of significance was noted in their previous histories.

THE CLINICAL COURSE.

Pre-paralytic stage. (First phase)

Russell Brain (1942) points out that there are often two phases in the pre-paralytic stage. The first lasts one or two days, with fever, malaise, headache, drowsiness or insomnia, and often gastro-intestinal disturbance. It is sometimes followed by temporary improvement and remission of fever for forty-eight hours, or it may merge into the second phase. Faber (1933) quoted by Russell Brain (1942) interprets these symptoms as being due to invasion of the hypothalamus by the virus.

Of the sixteen cases of acute anterior poliomyelitis in this series, five had been admitted to hospital or to Royal Naval sick quarters prior to the onset of the disease proper. Their symptoms are set out in Table I.

TABLE I.

Prodromal symptoms and signs.

Case No.	Temperature.	Headache	Shivering	Gastro-intestinal upset.	Length of remission (days)
4	99°	moderate	No	Epigastric discomfort	5
7	101.4°	moderate	Yes	-	8
10	98°	vague	Yes	-	5
11	98.6°	none	Yes	Nausea	4
13	100.8°	severe	Yes	-	5

Three other patients had had a "cold in the head" for some days prior to admission.

The five cases in Table I showed remissions lasting from four to eight days, which is considerably longer than the period mentioned by Russell Brain (1942). It is open to doubt whether the prodromal illness is the invasion stage of poliomyelitis or whether it is due simply to one of the minor febrile upsets which are so common in a sub-tropical country. It may be that such a temporary lowering of resistance aids invasion of the central nervous system by the virus, in a patient who might otherwise have had a sub-clinical or abortive attack.

Wells (1932, quoted by Russell Brain 1942) states that there is evidence that immunity may develop without illness. Russell Brain (1942) mentions an abortive form of poliomyelitis, a mild general infection without involvement of the central nervous system. Pette (1942) does not admit this form. I am inclined to think that the prodromal illness in my cases was part of the disease process, with a longer remission than is seen in children. Case 10, who had neck stiffness, and Case 11, with muscle pain, give support to this view.

Three other patients had been given multiple inoculations, all at the same sitting, a few days prior to admission. It is impossible to say whether the inoculations precipitated a clinical infection. As a precaution,/

precaution, all inoculations were stopped during the epidemic and it was advised that, in any case, all three inoculations (T.A.B. tetanus toxoid, and typhus exanthematous vaccine) should not be given on the same day, especially in view of the occurrence of 3 cases of encephalitis within 1-3 days of inoculation (Cases 17, 18, 19).

Pre-paralytic stage (second phase).

Table II shows the symptoms and signs of the second phase arranged in order of frequency.

TABLE II.

The appearance of the patient calls for comment. Six of the patients looked ill on admission to hospital. The remainder simply looked a little feverish. It is striking to look back on the four who died. Not one of them appeared to be ill at first; Cases 6 and 11 actually arrived as walking patients. The deceptive appearance of the patient is also illustrated by Cases 12 and 13, who arrived in the same ambulance. Case 13 looked definitely ill, but later showed only a transient paresis. Case 12 had a good colour and a bright eye on admission to hospital, but shortly developed a paraplegia.

When first seen, six of the patients gave the impression of being apprehensive, even early in the epidemic/

TABLE II.

Pre-paralytic stage.

Case Number	1	2	3	4	5	6	7	8	9
Duration of fever (hours)	96	36	48	48	16	24	48	16	48
Highest temp.	102	98.4	101	101	101	102	101	99	102
Headache	++	-	++	+++	+++	++	+	+++	++
Neck stiffness	+	-	+	+	+	+	+	++	++
Shivering	-	-	++	-	+	+	+	+	+
Backache	-	+	+	++	+	-	++	-	-
Limb pains	+	+	-	-	+	-	+	-	-
Restlessness	-	-	-	-	+	-	+	-	-
Muscle tenderness	+	-	-	++	+	-	+	-	+
Ill appearance	+	-	+	-	-	-	+	+	+
Apprehension	-	-	-	-	-	+	+	+	-
Eye pain	-	-	-	+	+	-	+	+	-
Sweating	-	-	+	-	+	-	+	-	-
Kernig's sign	+	-	+	-	+	-	-	-	-
Giddiness	-	-	-	-	-	-	+	-	+
Sore throat	-	-	+	-	-	-	+	-	+
Photophobia	-	-	-	-	-	-	-	-	+
Nausea	+	-	-	-	-	-	-	-	+
Vomiting	+	-	-	-	-	-	-	-	-
Diarrhoea	-	-	-	-	-	-	-	-	+
Red conjunctivae	-	-	-	+	-	-	-	+	-
Anonexia	-	-	-	+	-	-	-	-	-
Tendon reflexes*	N	N	N	N	Ex	N	D	N	D

* N = normal, Ex = exaggerated, D = diminished.

TABLE II. (continued)

Case Number	10	11	12	13	14	15	16	Total.
Duration of fever (hours)	24	24	36	36	36	60	36	
Highest temp.	100	101	101	104	100	103	103	
Headache	++	++	+	+++	+++	+++	++	15
Neck stiffness	+	+	+	+	++	+	+	15
Shivering	+	+	+	+	+	-	+	12
Backache	-	-	+	-	++	++	+	9
Limb pains	+	-	++	+	+	+	-	9
Restlessness	-	-	+	+	+	+	+	7
Muscle tenderness	+	-	+	-	-	-	-	7
Ill-appearance	-	-	-	+	-	-	-	6
Apprehension	++	-	-	+	+	-	-	6
Eye pain	-	-	-	-	+	+	-	6
Sweating	-	-	-	+	-	-	-	4
Kernig's sign	-	-	-	-	+	-	-	4
Giddiness	+	-	-	-	-	-	-	3
Sore throat	-	-	-	-	-	-	-	3
Photophobia	-	-	-	+	-	+	-	3
Nausea	-	-	+	-	-	-	-	3
Vomiting	-	-	-	-	-	+	-	2
Diarrhoea	-	-	-	-	-	+	-	2
Red conjunctivae	-	-	-	-	-	-	-	2
Anorexia	-	-	-	-	-	-	-	1
Tendon reflexes	N	N	N	N	N	D	D	

epidemic before precautionary measures caused alarm and despondency in the Naval Base. For example, Case 10 was in the ward for some days. After three days his fever and symptoms disappeared. It was intended to discharge him from hospital, but he seemed inexplicably apprehensive. He had an attack of tachycardia and simulated a case of effort syndrome. Two days later, he developed poliomyelitis.

The fever showed wide variation in its maximum height, from normal to 103.8°F, with an average of 101.2°F. The height of the fever in the pre-paralytic stage bore little relation to the severity of the disease process. Case 11, with a maximum temperature of 100.8°F, died, while Case 13, whose temperature reached 103.8°F, was left with no permanent paralysis. The approximate duration of the fever, from the onset of febrile symptoms, such as shivering, to the first sign of paralysis, varied from sixteen to ninety-six hours with an average of forty hours. In the four cases who died, the average duration of fever was twenty-five hours, and in the cases who recovered, was forty-four hours.

Headache was present in all cases except the ambulant one (Case 2). It was slight in two cases and moderate or severe in thirteen, usually frontal, occasionally occipital.

Neck stiffness was also found in all but the ambulant/

ambulant case. In only three cases did it amount to real rigidity. In a few cases it was purely subjective and could not be detected on examination. In the majority of cases it was slight: when the head was flexed the chin reached to within a finger's breadth of the sternum. Within twelve hours or so the stiffness usually increased and the chin could not be brought forward quite so far.

The pain felt on flexing the head was usually surprisingly slight and almost always referred to the lower thoracic or lumbar spine. Only in cases 6 and 11, who later died, was the pain felt at the occiput. In two cases, when the head was flexed, the chin came halfway to the sternum and then the shoulders lifted off the bed. These findings correspond with the observation of Petto (1942) that the intensity of the neck rigidity is rarely so marked as in meningococcal meningitis. In my series, the neck stiffness was usually present till the temperature became normal. Kernig's sign was never marked. Usually it was very doubtful.

Shivering was a common complaint but with, to my mind, a striking absence of sweating. Only four patients had noticed the latter symptom. Russell Brain (1942) mentions sweating as being found at this stage, but does not mention shivering. Petto (1942) also states that there is often profuse sweating.

Backache and limb pains were complained of in nine cases,/

cases, sometimes severe, sometimes transient, and not related to any particular type of case. In seven cases, muscle tenderness, frequently transient, was elicited.

Restlessness was complained of in seven cases, due to headache, backache or muscle pain.

Eye symptoms and signs were not frequent. In six cases, pain was felt on extreme lateral movement of the eyes. This contrasts with the cases of "short term fever" in which pain on moving the eyes was a striking feature. Injection of the conjunctivae was present in only two cases, another sign differentiating poliomyelitis from sandfly fever or "short term fever". Only three patients complained of photophobia in the pre-paralytic stage.

The reflexes were variable. On admission to hospital, they were within normal limits in nine cases, diminished in four and exaggerated in one case. The earliest sign of the onset of paralysis was diminution of the appropriate reflex, even when no muscle weakness could be detected. In addition, the reflexes generally tended to become diminished as the disease progressed.

Gastro-intestinal upset was present in five cases.

The remaining symptoms are noted in Table II.

The Paralytic Stage.

Table III summarises the findings in the paralytic stage. Since cases 10 and 15 did not develop paralysis, they are not included.

TABLE III./

TABLE III.

The Paralytic Stage.

Case	Duration of fever in hours	Time for development of paralysis in hours	Region Involved				
			Arm	Leg	Respiratory muscles.	Bladder	Abdomen
1	120	48	R	-	+	-	+
2	-	0	-	L	-	-	-
3	72	36	L	B	+	+	+
4	48	0	-	R	-	-	-
5	53	42	L	B	+	+	+
6	43	14	B	B	+	+	+
7	24	8	R	L	-	-	-
8	12	12	R	-	-	-	-
9	48	24	-	R	-	+	-
11	48	48	B	-	-	-	-
12	60	60	B	B	-	+	+
13	36	24	B	-	-	+	-
14	84	72	B	B	+	+	+
16	96	5	L	-	-	-	-
Av.	53	28					

* B signifies both limbs involved.

The duration of fever has been taken from the first sign of weakness till the fever settled, or till death. The average duration was just over two days. Pette (1942) states that pyrexia continuing after the establishment of paralysis is a bad sign. In my cases this was not always so. In Case 1, mild pyrexia continued for three days after the establishment of maximal paralysis; in Case 16, paralysis was maximal in five hours but a temperature of 102°F. for a further 1½ days gave cause for concern.

The average length of time from the onset to the full development of paralysis was 28 hours. Of the six cases in which the spread of paralysis continued beyond 24 hours, three died and the other three were left with a serious degree of paralysis. Price (1934) states that "the paralysis seems to have its full limit of distribution at the moment of its appearance" and Russell Brain (1942) that "usually the maximum damage is done in the first 24 hours." Both authors mention that some cases are progressive, usually of the ascending type. It seems that, in the present series, an unusually high proportion (more than one third) have been of the progressive type. This has also been observed in the Middle East. An Army booklet, Notes on Nervous Diseases and Head Injuries in the Middle East 1943*, points out that "a number of cases were of/

* This will be referred to as "the Army booklet".

of the ascending type; symptoms continued to develop during two or more days."

In only five cases did the paralysis reach its full limit of distribution shortly after its appearance. In the remainder it was progressive over a period of 24 hours or more.

The cases might be grouped as follows:-

Pre-paralytic	2	Cases 10, 15
Ascending	4	Cases 3, 5, 6, 14
Encephalitic	1	Case 1
Brain stem form	1	Case 11
Spinal form	8	Cases 2, 4, 7, 8, 9, 12, 13, 16

This grouping is somewhat artificial. Both the encephalitic and the brain stem cases had spinal involvement as well.

The detailed distribution of the paralysis is set out in Table IV. Since the cases who died had multiple paralyses, it is of value to set out the surviving cases separately.

TABLE IV./

TABLE IV.

Distribution of paralysis (including transient weakness)

	Including cases who died (16)			Excluding cases who died (12)		
	One side	Both sides	Total	One side	Both sides	Total
Triceps	6	4	10	5	2	7
Quadriceps	3	6	9	3	3	6
Hamstrings	3	6	9	3	3	6
Abdominals	1	7	8	1	4	5
Bladder			7			4
Deltoid	2	5	7	2	2	4
Leg muscles	2	4	6	2	2	4
Forearm muscles	4	2	6	3	-	3
Respiratory muscles			5			2
Biceps	2	-	2	1	-	1
Gluteal muscles	1	2	3	1	-	1
Spinati	1	-	1	1	-	1
Trapezius	1	-	1	1	-	1
Cranial nerves	-	5	5	-	1	1

The triceps and the thigh muscles were those most commonly involved, with the abdominal muscles, bladder and deltoid muscle next in order of frequency. In just under a quarter of the surviving cases the limbs were involved bilaterally, but in practically no case were they involved simultaneously or to an equal extent. Russell Brain points out that the paralysis is usually asymmetrical and patchy. Pette states that it is exceptional for both limbs to be involved, but there was a lasting bilateral paralysis of the thigh muscles in Cases 3 and 12. Cases 1 and 11 showed weakness of the ocular muscles, which also is rare according to Russell Brain.

Much of the paralysis was transient, the affected muscles recovering within a few days; Cases 7, 8, 9 and 13 are examples. The authorities are agreed that only a proportion of the affected muscles remain paralysed. The bladder was involved in seven cases, four requiring repeated catheterisation. In Case 3, the bladder muscle did not recover for three weeks. In the early stages there was complete absence of retraction of this bladder. The urine had to be expressed by gentle suprapubic pressure and, when the pressure was released, air was sucked back into the bladder. The same absence of retraction was observed in the case of transverse myelitis, Case 23. Case 12 required catheterisation for two days and Case 13 for twenty-four hours.

In/

In Case 9, the bladder disturbance lasted only twelve hours and responded to the administration of a warm enema. This patient had had no difficulty in using a urinal during the two previous days in bed, so I think this retention was due to a transient organic lesion. Russell Brain states that sphincter disturbance is extremely rare except in cases where the pyramidal tract is involved. Price and Pette, on the other hand, state that urinary retention is frequent. Cases 3 and 5 showed extensor plantar responses. In the other five cases who had retention of urine, there was no evidence of pyramidal tract involvement.

Paralysis of the muscles of respiration occurred in five cases. In two of them it was not sufficiently severe to require artificial aid. The weakness lasted seven days (Case 1) and four days (Case 3) respectively. Case 1 was an officer who was very keen on physical training and was accustomed to do exercises every day. I consider that, but for his physical fitness prior to his illness, he would have required artificial respiration.

All the three cases who had to be put in the Drinker type respirator died of bulbar paralysis. It seemed that any case who was so paralysed as to require artificial respiration and who still had pyrexia, was unlikely to survive.

Pre-paralytic/

Pre-paralytic Cases.

Cases 10 and 15 merit more detailed discussion. Case 10 was admitted during the epidemic with normal temperature, tenderness of the gluteal muscles, leucocytosis and slight neck stiffness which increased. The cerebrospinal fluid was found to be normal, except that it appeared to be under increased pressure. A course of 250,000 units of Penicillin was given by the intramuscular route. The leucocytosis became less and the signs disappeared. He was about to be discharged from hospital three days later when he had an attack of tachycardia and was apprehensive for no apparent reason. Symptoms increased during the next two days till he had severe headache and increasing neck stiffness. The cerebrospinal fluid on this occasion showed pleocytosis and increased protein. No muscle weakness or alteration of reflexes could be detected. This seems to me a good example of poliomyelitis which did not go beyond the pre-paralytic stage.

One cannot make such a definite diagnosis in Case 15. He complained of diarrhoea for the previous three days, headache, severe backache and pain in the legs. He had slight photophobia and stiffness of the neck muscles. The tendon reflexes in the legs were diminished and there was slight leucocytosis. In spite of normal findings in the cerebrospinal fluid, I gave him intrathecal penicillin, as an early case of poliomyelitis.

He had a severe meningitic reaction (to be discussed/

discussed later). In addition, the abdominal and leg reflexes disappeared and the arm reflexes became diminished. There appeared to be slight weakness of the quadriceps and hamstring muscles bilaterally, but this may have been due to his poor general condition. In addition, there was tenderness in the left calf. The reflexes returned and the weakness disappeared in three days.

Possible diagnoses were:-

(1) A meningeal reaction to dysentery, but the diarrhoea was slight and an exudate was found on only one occasion.

(2) A meningeal reaction following the multiple inoculations which had been given three days before the onset of symptoms. This interval seems too long and there was no evidence of encephalitis, as occurred in cases 17, 18 and 19.

(3) Acute anterior poliomyelitis which ceased at the pre-paralytic stage. This diagnosis is favoured by the transient absence of tendon reflexes, weakness of thigh muscles and tenderness of the left calf.

TABLE V.

TABLE V.

The White Blood Cell Count in 15 cases of Acute Anterior Poliomyelitis.

Case No.	Date	Total W.B.C. count	Polymorphs %	Lympho-cytes %	Mono-cytes %	Eosino-phils %
1	July 21	9500	51	44	2	3
3	Sept.17	7100	73	26	1	-
4	Sept.16	9800	64	34	1	1
5	Nov. 6	14300	74	17	9	-
6	" 12	15800	85	9	6	-
7	" 13	11050	73	21	6	-
8	" 14	10900	66	23	10	1
9	" 19	14550	78	13	9	-
10	" 14	16150	74	22	2	2
10	" 15	13150	66	27	5	2
10	" 17	14550	75	13	7	5
10	" 22	9050	72	13	15	-
11	Dec. 3	16850	81	15	4	-
12	" 5	10100	78	17	5	-
13	" 5	14000	80	9	11	-
14	" 5	9450	73	11	14	2
15	" 6	10750	72	23	5	-
16	" 11	15050	88	5	7	-

TABLE VI.

Findings in the Cerebro-Spinal Fluid in 15 cases of Acute Anterior Poliomyelitis.

Case No.	Date	No. of cells per cu.mm.	Polymorpho-nuclears %.	Lymphocytes %	Protein mgms. per 100 ccs.
1	July 23	1400	10	90	60
3	Sept.17	66	10	90	180
4	" 18	110		100	150
5	Nov. 6	400		100	45
5	" 6	220		100	55
5	" 7	84		100	75
6	" 12	400	80	20	95
6	" 12	2000	80	20	120
7	" 13	80	40	60	70
7	" 13	180	30	70	75
7	" 14	250	30	70	60
8	" 14	480	45	55	70
8	" 14	500	25	75	80
8	" 15	300	16	84	90
9	" 19	1580	75	25	90 clotte
9	" 20	1860	80	20	75
9	" 20	1520	50	50	55
10	" 15	3		100	30
10	" 23	100	4	96	45
11	Dec. 3	1795	60	40	95
11	" 4	82	40	60	85
11	" 4	305			80
12	" 5	620	60	40	75
12	" 6	406	40	60	80
13	" 5	430	50	50	80
13	" 6	380	50	50	70
13	" 6	180	30	70	60
14	" 6	1050	60	40	110
14	" 7	265	25	75	110
15	" 7	4		100	20
15	" 7	550	70	30	Clotted
15	" 10	149	30	70	55
16	" 11	550	65	35	65
16	" 12	760	60	40	80

The White Blood Cell Count.

Table V shows the count in fifteen cases. The total count varied from 7,100 cells per cu.mm. to 16,850 cells per cu.mm. There was a leucocytosis, with an average of 73.5% neutrophil polymorphonuclear cells and 18.8% lymphocytes. This corresponds to the usual findings.

The Cerebro-spinal Fluid.

The findings in the cerebro-spinal fluid are set out in Table VI. There being no manometer available, the pressure was estimated by counting the number of drops per minute. Sixty drops per minute was taken as the upper limit of normal. In Cases 1, 3 and 4, the examination was carried out after the onset of paralysis. In the other cases, it was done in the pre-paralytic stage.

The cell count varied from 66 to 2000 per cu.mm. In individual cases, the count sometimes rose and sometimes dropped within twenty-four hours. No relationship could be made out between the cell count and the severity of the disease process. In most cases there was a rapid change from a predominance of polymorphonuclear cells to a high percentage of mononuclear cells. In Case 5, there was a pure lymphocytosis. These findings correspond to what is usually found.

In/

In cases where there was a large number of cells, the estimation of protein was made on the supernatant fluid after centrifugalisation. In seven cases, there was an increase in protein disproportionate to the cell count (dissociation) but this feature was not marked. In four cases, the amount of protein decreased in successive specimens. Two of the specimens formed a spider-web clot after two hours standing. In none of the specimens was there found a decrease in the amount of sugar, nor a growth on culture, and no organisms were seen in the stained deposits after centrifugalisation.

Autopsy Findings.

In the four fatal cases, autopsy confirmed the diagnosis. Degeneration of nerve cells in the anterior horns of the spinal cord, lymphocytic perivascular cuffing and small haemorrhages in the grey matter are usual findings in acute anterior poliomyelitis. (Russell Brain 1942).

Differential Diagnosis.

The cases numbered 17 to 24 are cases of interest in the differential diagnosis of acute anterior poliomyelitis, who have been under my care. I shall now discuss these, along with the other conditions which require to be differentiated from it.

Reaction/

Reaction following multiple inoculations.

Cases 17, 18 and 19 presented a considerable problem in diagnosis. On the day on which they were all admitted (1st December 1944) there had already occurred a number of cases of poliomyelitis, and during the following four days, Cases 11, 12 and 13 were admitted. They presented symptoms and signs suggesting acute anterior poliomyelitis in the pre-paralytic stage and, consequently, were at first treated as such.

They had all been given multiple inoculations within the previous three days. Case 17 had noticed increasing frontal headache and had had a mild shivering attack a few hours before he was inoculated. By the evening, his temperature was 103°F. He complained of slight pain on flexing his head and on moving his eyes. There was moderate leucocytosis. By the following morning, there was an increase in the neck stiffness and some muscle tenderness. Examination of the cerebro-spinal fluid showed 8 lymphocytes per cu.mm. and a normal amount of protein.

I thought he might well be a case similar to Case 10, with a prodromal upset and gave one intrathecal injection of penicillin. It seemed to me that, if paralysis did develop later, this would indicate that penicillin was of little value. As it turned out, the meningeal irritation cleared up rapidly and the patient showed no diminution of reflexes nor muscle weakness.

Within/

Within a few days, he looked and felt fit, but he developed infective hepatitis.

The possibilities are that this case was:

(1) Poliomyelitis which did not go beyond the pre-paralytic stage. In favour of this is the muscle tenderness; against it is the low cell count in the cerebro-spinal fluid. Russell Brain (1942) states that absence of pleocytosis is rare. Price (1934) on the other hand, states "we have seen the cerebro-spinal fluid normal throughout". The Army booklet on nervous diseases in the Middle East (1943) states that two cases were found with a normal cell count in the cerebro-spinal fluid during the first forty-eight hours of the paralytic stage, but that this is extremely rare.

(2) This may have been purely a reaction to inoculation.

(3) As I have occasionally seen, a prodromal upset some days before the development of jaundice in cases of infective hepatitis, but without stiffness of the neck.

On the other hand, any lowering of resistance may be followed by infective hepatitis. I have seen it occur following cases of tonsillitis, scarlet fever, acute lobar pneumonia and malaria.

To my mind, it is impossible to make a definite diagnosis in this case, but in view of the low cell count in the cerebro-spinal fluid, I have placed it in the/

the group of inoculation reactions.

Cases 18 and 19 showed signs of encephalitis. They were unduly alert, particularly the latter, who sat bolt upright in bed when one came to the door of his room. Both patients had very brisk reflexes, nystagmus and intermittent diplopia. The only sign of muscular weakness was a transient retention of urine in Case 18. Petto (1942) states that a pure encephalitis without spinal involvement never occurs in poliomyelitis. These were possibly cases of acute disseminated meningo-encephalitis, to be mentioned later.

"Short Term Fever".

I mention this condition because three cases presented a clinical picture similar to the pre-paralytic stage of acute anterior poliomyelitis.

Between the beginning of August and the middle of October 1944, twenty-nine cases with a similar clinical picture were admitted to the detachment. All medical officers to whom I have spoken are agreed that such cases are common in the Mediterranean area. In most cases they are labelled "Sandfly Fever".

The clinical picture in my cases was of a short, sharp fever lasting two to five days, usually three days. The highest temperature reached was usually 102°F. In only two cases did it rise to 104°F. The onset was very sudden, without a prodromal illness. The patient often mentioned the hour at which it started.

Although/

Although the symptoms in my cases of acute anterior poliomyelitis were rapid in onset, the headache and malaise were not maximal for 12-24 hours. In the cases of "short term fever", the symptoms were maximal in a very short time: a number of the patients were beginning to feel better by the time they were admitted to hospital.

Severe headache, mainly frontal, was almost universal. In 20 out of the 29 cases there was severe pain on moving the eyes. Two patients would not try to look sideways on account of the pain it caused. Conjunctival injection was a common finding. In only one case was there a "saddleback" type of fever, the temperature showing a secondary rise after being normal for 24 hours. Usually the temperature fell by lysis. Malaria was, of course, excluded by the absence of parasites in repeated thick blood films and by the fact that fever did not recur. No signs of any other disease were found. In the majority of cases, there were no abnormal signs. A few showed reddening of the fauces, with small vesicles. No abnormalities were found in the central nervous system except that five cases had stiffness of the neck. The three whose signs were sufficiently severe to warrant the performance of lumbar puncture are described - Cases 20, 21 and 22.

In all 29 cases, a count of the white blood cells was performed. The average findings were - total white blood/

blood cells, 5,330 cells per cubic millimetre; average differential count, neutrophil polymorphonuclear cells 56%, lymphocytes 35%, monocytes 8%.

There were some features which did not justify a diagnosis of phlebotomus fever. The cases occurred sporadically over a period of 2½ months. If this were true sandfly fever, one would expect a more explosive outbreak. The patients came from scattered areas in only some of which sand flies were found, and few of the cases gave a history of recent bites. In other respects also, they differed from the description given by Manson-Bahr (1942). The illness was, as a rule, shorter - 2-3 days as against 3-4. There was no evidence of irritating bites. The fever was less high, only reaching 104°F. in two cases. There was a "saddle-back" temperature chart in only one case. Bradycardia was present in only three cases. Mental depression was, in most cases, conspicuous by its absence. The majority of the patients were lively as soon as the temperature settled.

Accordingly, it seems less inaccurate to call these cases "Short Term Fever". It may be that they were cases of benign lymphocytic chorio-meningitis. The Lancet (1942) in a leading article quotes Armstrong (1941), Farmer and Janeway (1942) and Armstrong and Hornibrook (1941) as describing a non-meningeal form. It was not possible for me to have a blood complement fixation test performed.

The/

The three cases who required the performance of a lumbar puncture presented the same symptoms and signs as the remainder, but with marked neck rigidity. In them, the leucopenia was absent. The average of nine white blood cell counts was 8,140 cells per cubic millimetre, with 70% neutrophil polymorphonuclears, 23% lymphocytes and 7% monocytes.

The Army booklet (1943) points out that the differential diagnosis between acute benign lymphocytic meningitis and sandfly fever may be impossible. Between the former and acute anterior poliomyelitis, it may be difficult.

The differentiation between these cases of "Short Term Fever" and my cases of poliomyelitis in the pre-paralytic stage rests on the following:-
The severe eye pain and conjunctival injection are much more marked than in poliomyelitis; there is no paralysis following the acute illness: an important difference is in the white blood cell count, which may be normal, but usually shows a leucopenia with relative lymphocytosis and monocytosis, whereas in acute anterior poliomyelitis, there is usually a leucocytosis. On the other hand, the findings in the cerebro-spinal fluid are similar in the two conditions.

Acute/

Acute transverse myelitis.

Case 23 had been given anti-diphtheritic serum five days before the onset of nervous symptoms. He had very severe lumbar pain followed by paraplegia 36 hours later. He had a temperature of 101°F and moderate leucocytosis. There were no meningitic symptoms or signs. The paralysis affected the left leg more than the right; the proximal segments were more involved than the distal ones; there was practically no sensory loss, only subjective paraesthesia in the legs and doubtful diminution of appreciation of light touch, heat and cold. Thus the condition bore a marked similarity to acute anterior poliomyelitis.

However, I consider it was transverse myelitis, an unusual reaction to the serum. The points against a diagnosis of acute anterior poliomyelitis are:-
The patient had been in a small detachment in the country and had no contact with the Naval Base in which the other cases of acute anterior poliomyelitis occurred. Poliomyelitis did not develop subsequently in any of the other men in the detachment. There was considerable tenderness over the upper lumbar vertebrae, which I have not observed in poliomyelitis.
The development and persistence of a bilateral extensor plantar response is another point against poliomyelitis. The loss of sphincter control was of little help in diagnosis, since it occurred in more than one quarter of my/

my cases of poliomyelitis.
Syphilitic myelitis was excluded by the Kahn test.

I do not know of myelitis occurring as a diphtheritic manifestation. This was clinically not a case of diphtheria. Russell Brain (1942) states that transverse myelitis may be due rarely to toxins such as sulphanilamide and that it may also be caused by the viruses of poliomyelitis and of lymphocytic chorio-meningitis.

Meningitic Serum reaction.

In Case 24, features which distinguished it from poliomyelitis in the pre-paralytic stage were urticaria, arthritis and the severe meningitic reaction seven days after the administration of anti-diphtheritic serum: the headache was occipital and the pain on flexing the head was felt in the neck.

Acute lymphocytic choriomeningitis.

The onset in this condition is very similar to that of acute anterior poliomyelitis, with signs of meningeal irritation and possibly, prodromal signs of systemic upset. There is occasionally facial paralysis and, rarely, paraplegia and retention of urine. (Russell Brain 1942).

The Lancet (1942) points out that the aetiology of this condition is doubtful in two-thirds of the cases. Petto (1942) suggests that the virus of poliomyelitis may be the cause of aseptic meningitis and lays stress on his contention that meningeal reactions in virus infections/

infections are of a non-specific hyperaemic nature, so that any virus may give rise to a meningitis.

In the absence of paralysis, differential diagnosis may be very difficult. Usually the cell count in the cerebro-spinal fluid in lymphocytic choriomeningitis is high, with a high proportion of lymphocytes, though a polymorphonuclear pleocytosis may be found in the first 48 hours. Russell Brain (1942) states that half the cases show over 1,000 cells per cubic millimetre at some stage. The pleocytosis is often remarkably persistent, in comparison with the quick return to a low cell count in poliomyelitis. The similarity of the condition to "short term fever" has already been mentioned.

Acute disseminated meningo-encephalitis.

This condition occurs as a complication of specific fevers such as smallpox, vaccinia and mumps. The Army booklet mentions it as a rare complication of lympho-cytic chorio-meningitis. Pette (1942) considers that great care should be taken to distinguish it from acute anterior poliomyelitis. He mentions the following points:-

The occurrence of unconsciousness or convulsions is definitely against poliomyelitis and the paralysis is often unilateral as a result of cortical damage; despite the flaccid paralysis there are always pyramidal signs.

There/

There will usually be a history of a causal condition, such as vaccination.

Acute infective polyneuritis.

Russell Brain (1942) states that this condition is rare and sporadic, but may assume epidemic proportions. He describes it as a febrile illness with headache, vomiting and pain in the back and limbs, associated with neck stiffness. After a latent period of days or weeks, there is sudden paralysis, with headache and sometimes recurrence of pyrexia. The paralysis may affect all the limbs or spread from the lower to the upper limbs. All the muscles in a limb are usually affected. Usually there is pain, numbness, tingling or muscle tenderness in the affected limbs. The sphincters are rarely affected. In severe cases, the neck, trunk and respiratory muscles may be affected.

Features which distinguish it from acute anterior poliomyelitis are:- the characteristic bilateral facial palsy; the sensory loss which is constantly present but is variable in extent; the fact that the paralysis is symmetrical as opposed to the patchy involvement in poliomyelitis; the great excess of protein in the cerebro-spinal fluid, which may persist for weeks after recovery (the "dissociation albumino-cytologique" of Guillain and Barre).

Infective neuritis.

The Army booklet uses this term to describe a group of cases characterised by paralysis of muscles supplied/

supplied by one or more peripheral nerves. Not infrequently, it occurs while the patient is in hospital with some other disease. Pain usually precedes muscular weakness by some days. The cerebro-spinal fluid has been normal in those few cases in which it has been examined. It is distinguished from acute anterior poliomyelitis by:-

The absence of fever and constitutional symptoms; the normal cerebro-spinal fluid in the acute stage (the booklet states that this point requires further verification)

There may be sensory loss.

The paralysis follows a peripheral nerve rather than a segmental distribution. In paralysis of the shoulder girdle group of muscles, the deltoid usually escapes. The booklet states that, in acute anterior poliomyelitis, the deltoid muscle rarely escapes - the present series of cases does not bear this out.

<u>The ascending form of acute myelitis</u>.

Russell Brain (1942) points out that this condition also may cause widespread flaccid paralysis but, to distinguish it from poliomyelitis, the plantar responses are extensor, there is extensive sensory loss and the sphincters are involved.

<u>Landry's Paralysis</u>.

Russell Brain (1942) defines this as a syndrome of unknown and probably varied aetiology, characterised by flaccid/

flaccid paralysis which involves first the lower, then the upper limbs and terminates as a bulbar paralysis. Pathologically, perivascular infiltration of the spinal cord is inconspicuous.

Russell Brain thinks this may be a manifestation of poliomyelitis, particularly when there is a lymphocytic pleocytosis in the cerebro-spinal fluid. He points out that in an epidemic of poliomyelitis, some cases are of this type. In my series, Cases 5, 6 and 14 were of this type.

Epidemic encephalitis lithargica.

This may be similar to the bulbar type of poliomyelitis, but the onset is less acute, there is an absence of neck rigidity and pupillary disturbances are almost constant.

Other forms of epidemic encephalitis.

The Japanese type "B", the St. Louis type and Australian "X" disease seldom show cranial nerve palsies or gross limb palsies. Mental confusion, tremors, drowsiness and hyperexcitability are distinguishing features. As already mentioned, a pure encephalitis does not occur in poliomyelitis.

Haematomyelia.

This commonly affects the cervical enlargement. The presence of sensory loss, exaggerated reflexes in the legs and pyramidal lesions will differentiate it from poliomyelitis.

Cerebro-spinal/

Cerebro-spinal fever.

In this, there is more marked photophobia, and the neck rigidity is more definite, with pain felt in the neck on attempted flexion of the head. Petechial haemorrhages will also help to distinguish it from poliomyelitis. In the cerebro-spinal fluid, the pleocytosis is polymorphonuclear and the meningococcus will be found on culture or in direct smears of the cells: the amount of sugar in the cerebro-spinal fluid is reduced.

Pyogenic meningitis.

The distinguishing physical signs are the same as in cerebro-spinal fever. The causative organism will be found in the cerebro-spinal fluid.

Tuberculous meningitis.

This is rare in adults but may cause difficulty in diagnosis in children. The onset is more gradual. The child is pale rather than flushed. There is diminution in the chloride content of the cerebro-spinal fluid. A spider-web clot on standing is much more common in tuberculous meningitis, although it occurred in two of my cases of poliomyelitis. The tubercle bacillus may be found in the deposit after centrifugalisation of the cerebro-spinal fluid.

Relapsing fever.

In a tropical country, the meningitic form of this disease may cause confusion. Meningitis occurs in 20% of cases in the third or fourth relapse (Army booklet).

It/

It may be distinguished by the history of two or three febrile attacks, with headache, at intervals of 7 - 14 days. Facial, or other cranial palsies, sometimes occur.

COMPLICATIONS.

Case 9 developed an anaemia of hypochromic type for which no other cause could be found. Presumably it was due to the general infection with the virus. It responded to iron therapy.

The other complication in this series was urinary infection, which developed in three cases of poliomyelitis (Nos. 3, 13 and 15) and two other cases (Nos. 18 and 23). In Case 15, retention of urine had not occurred. It seems likely that this was a blood borne infection following the diarrhoea which troubled him in the early stage of the illness. Probably the severe illness which he developed lowered his resistance to infection by coliform organisms.

Cases 13 and 18 had been catheterised only once. The development of this infection is disappointing because every care was taken to avoid introducing infection when the catheter was passed. They serve to emphasise the necessity of avoiding catheterisation if possible. Cases 3 and 23 were catheterised frequently. In future, if bladder paralysis lasts longer than 24 hours, I consider it would be wiser to use an indwelling catheter. In the cases treated in a respirator, there

was/

was not time for the development of urinary or respiratory infection.

I did not have the opportunity of watching for late complications such as stretching of paralysed muscles. In Case 23, an unstable knee joint resulted.

PROGNOSIS.

Table VII shows the progress made by the cases after eight weeks.

TABLE VII.

Results after 8 weeks in 16 cases of poliomyelitis.

Cases developing no paralysis	2	
Cases showing transient paralysis	4	
Cases fit for duty in 8 weeks		6
Cases with lasting paralysis		6
Deaths		4
		16

The four deaths in sixteen cases are in accordance with the statement by Russell Brain (1942) that the mortality rate may be as high as 25% especially in patients attacked after the fifth year. Death in all these cases was due to bulbar paralysis.

Of the six cases who were evacuated to another hospital, I heard later that Cases 2, 4 and 16 recovered a useful degree of function, so that only three cases were left with disabling paralysis. Case 1 had paralysis of the right deltoid and biceps muscles, with paresis of the triceps and trapezius muscles. Case 3 had paralysis of the abdominal and thigh muscles bilaterally. In Case 12, both legs and the left triceps muscle were paralysed. Russell Brain (1942) states that/

that improvement may occur over a period of six months to two years. Where the paralysis in a muscle is incomplete, or where the reflex returns quickly, the outlook for that muscle is good.

TREATMENT.

As a preventive measure, all suspect cases were isolated. Fortunately a number of small rooms were available, and it was possible to keep all cases in single rooms till the temperature was normal and the spread of paralysis had ceased.

All attendants wore gowns and masks. The excreta were disinfected before disposal.

Patients were kept isolated for three weeks.

The patients were kept at complete rest and examination of weak muscles was reduced to a minimum. Analgesics were given for the headache and backache.

After two weeks or a little longer, patients were encouraged to exercise the weak muscles actively. The affected joints were moved twice daily, actively if possible.

Care was taken to avoid over-stretching of paralysed muscles. When the deltoid muscle was weak, the arm was kept abducted by means of a sling fixed to the head of the bed. Where there was paralysis of leg muscles, the leg was fixed between pillows to prevent outward rotation, or flexion of hip or knee. Drop foot was prevented by a light, bivalved plaster.

Sister Kenny's regime was not adopted. Where there was severe pain, as in Case 12, hot fomentations relieved it.

The/

The paralysed cases were sent to the main hospital as soon as they came out of isolation, en route for an orthopaedic centre.

Treatment of the paralysed bladder has already been mentioned.

When paralysis of the respiratory muscles gave rise to cyanosis and distress, the Drinker type respirator was found efficient. When first put in, patients had difficulty in adjusting their respiration to coincide with the cycle of the machine but they settled down after half an hour or so. A speed of 20 to 22 respirations per minute was found to be the most satisfactory. Once the patient had settled down, the movement of the chest wall, as seen through the window, was excellent. There was no cyanosis.

After about two hours there was usually a bitter complaint of pain at the back of the neck and the patient begged to be taken out. Undoubtedly the sorbo rubber collar was uncomfortable, but I consider that some of the pain was due to the spreading upwards of the disease process. On the first occasion on which the patients were taken out, they usually had sufficient respiratory excursion to begin with, but became cyanosed after ten minutes and were very glad to be put in again.

When patients were taken out twice daily for attention to pressure points, continuous oxygen was given at the rate of 6-8 litres per minute by a Haldane mask and/

and artificial respiration was performed. Sylvester's method could not be used on account of the headboard of the apparatus, so the chest wall was pressed and released. Since there was no tone in the muscles, this was moderately effective. Two nursing sisters worked simultaneously and another medical officer changed the catheter.

Much trouble was experienced with mucus in the throat. This was usually worse after the patient had been taken out for attention. Atropine gr.$\frac{1}{100}$ by hypodermic injection was found effective in controlling it and was used laterally as a preliminary to taking the patient out.

When first put into the apparatus the patients could sip fluids between breaths, but within a short time nasal feeding had to be resorted to. Between feeds, the catheter was clipped off and left in position.

Phenobarbitone was used as a sedative.

Specific treatment.

Russell Brain (1942) quotes Schultz and Gebhardt (1933, 1934 and 1935) and Flexner (1938) as showing that a potent neutralising serum was ineffective if given more than 24 hours after nasal instillations in monkeys of the virus of poliomyelitis. He also quotes Park (1933) who, in nearly one thousand cases given convalescent serum in the pre-paralytic stage, found no significant difference between treated and untreated patients/

patients. Consequently my cases were not given convalescent serum nor blood transfusion from healthy men.

Penicillin.

This drug was tried out at the suggestion of Lt.-Col. G.S. Hall, R.A.M.C., Adviser in Neurology, Central Mediterranean Forces, not very hopefully in view of the previous experience with serum, quoted above; but it was felt that, in dealing with such a serious condition, any possible method of reducing mortality or morbidity should be investigated.

Eleven cases of acute anterior poliomyelitis were given penicillin sodium by the intramuscular and intrathecal routes: a twelfth case was given it by the intrathecal route only. The intramuscular injections were given in doses of 15,000 Oxford units every three hours in a strength of 5,000 units per cubic centimetre. A different site in the thigh was chosen for each injection. The injections were continued till the temperature became normal.

The intrathecal injections were given in a strength of 500 Oxford units per cubic centimetre. This was the strength advised by Lt.-Col. Hall as being the optimum for intrathecal use. The amount given was usually 10 or 12 ccs. giving a dose of 5000 or 6000 Oxford units, provided that a slightly greater amount of cerebro-spinal fluid had been withdrawn. 3 injections were given at intervals of 12 hours unless paralysis was obvious. In at least ten cases, the first intrathecal injection

was/

TABLE VIII.

Amounts of Penicillin given.

Case	Units by intramuscular route.	Number of intrathecal injections.	Units by intrathecal route.	Severity of headache following injection
5	255000	2	11000	+++
6	240000	2	11000	++
7	360000	3	17000	+
8	240000	3	18000	++
9	390000	3	18000	+
10	250000 *	1	7500	++
11	-	3	15000	+++
12	450000	2	10000	+
13	400000	3	15000	++
14	180000	2	10000	+
15	480000	1	3500	+++
16	455000	2	10000	+++
17	155000	1	6000	-
18	300000	-	-	

* Case 10 was given the intramuscular penicillin 5 days before the real onset of the pre-paralytic stage.

was given well before the first sign of paralysis appeared.

In Table VIII is shown the total amounts of penicillin given by each route: the severity of the headache following intrathecal injections is indicated also.

The number of cases is far too small for one to draw conclusions of statistical value, but, for what it is worth, Table IX shows the end result in patients treated with penicillin set out alongside my 4 cases of poliomyelitis and 6 cases of poliomyelitis which occurred in other parts of the hospital, and who were not given penicillin, during the same period.

TABLE IX.

Results of Treatment of Poliomyelitis.

	Without penicillin	Given penicillin
Cases showing no paralysis	2	2
Cases with transient paralysis	-	4
Cases with lasting paralysis	6	2
Deaths	2	4
	10	12

Case 10 is interesting. He was given a course of intramuscular penicillin. Five days after the course finished, he again developed symptoms of pre-paralytic poliomyelitis and showed a pleocytosis in his cerebrospinal fluid. In his case, penicillin by the intramuscular/

intramuscular route, given extremely early, did not prevent the development of the pre-paralytic stage. On the other hand, he was one of the patients who showed no paralysis.

It seemed that Case 17 was one who might have a prodromal illness of the same type. He was given one intrathecal injection as well as a course of intramuscular injections. As it turned out he developed no paralysis.

It is tempting, in the six cases who developed little or no paralysis, to assume that penicillin contributed to this happy result, but two other cases showed no paralysis, having had no specific treatment.

The four cases who died each had two intrathecal injections, the first one being given well before the appearance of any sign of paralysis; in fact, within two hours of the time when it was possible to recognise the cases as pre-paralytic poliomyelitis. All four cases died rapidly.

In view of this outcome, it seems that penicillin is of little or no value in the treatment of poliomyelitis.

It is necessary, also, to consider any possible ill-effects of one's method of treatment.

With regard to headache, I found it difficult to decide how much of the headache was due to the lumbar puncture, how much was due to the disease and how much was caused by the penicillin. It is recognised that injection/

injection of penicillin intramuscularly or into a serous cavity causes pain, so I think that at least some of the headache was due to penicillin. Case 11, who had troublesome vomiting, had an ascending type of paralysis which terminated in bulbar paralysis. Again it is difficult to assess what part was played by penicillin.

In Case 14, I consider that the severe lumbar pain was caused or much increased by penicillin. It was worse after each injection and became easier before the second injection was given.

Case 15 showed the symptoms and signs of meningitis, starting four hours after the intrathecal injection of penicillin. When intrathecal penicillin was given, the cerebro-spinal fluid was normal. Seven hours later, when lumbar puncture was performed on account of the headache, the cerebro-spinal fluid showed 550 cells per cu.mm. with 70% polymorphonuclear cells and a pellicle formed on standing. Three days later, the cerebro-spinal fluid contained 150 cells per cu.mm. mainly lymphocytes. The possibilities are that this was:-

(1) A coincidence, the injection simply preceding an exacerbation of the poliomyelitis disease process. This seems unlikely, in view of the severity of the reaction and the sudden onset within a few hours.

(2) A pyogenic meningitis. A few organisms may have been introduced at the same time as the penicillin. The infection might have been overcome rapidly by the intramuscular/

intramuscular penicillin and sulphapyridine soluble which were given. The change to lymphocytes in the cerebro-spinal fluid within three days and the rapid improvement are against this.

(3) A toxic effect of penicillin, possibly of the nature of sensitivity. It is interesting that this was the smallest amount of penicillin given in any intrathecal injection. I have not heard of toxic effects of penicillin or of sensitivity to it.

(4) Mechanical irritation. Pette (1942) discussing the serum treatment of poliomyelitis, states that he and many others doubt the advisability of using the intrathecal route on account of the risk of irritating the already inflamed meninges. Penicillin tends to be irritant. I consider this the most likely explanation.

CONCLUSIONS.

In adults, during the pre-paralytic stage, symptoms and signs which were found to be very suggestive of acute anterior poliomyelitis were headache, neck stiffness, shivering, backache, limb pain and moderate leucocytosis. There was surprisingly little pain on flexion of the head, what discomfort there was being referred to the lumbar region. The fact that the patient did or did not look ill was of no value, but unexplained apprehension was suggestive.

If acute anterior poliomyelitis is borne in mind, diagnosis in the pre-paralytic stage is not difficult, particularly during an epidemic.

The white blood cell count was of definite value in differentiating acute anterior poliomyelitis from "short term fever". It is suggested that the cases of "short term fever", which are described, might be cases of benign lymphocytic choriomeningitis.

Differentiation of the pre-paralytic stage from early meningo-encephalitis was impossible.

The height of the fever was of little value in indicating the severity of the condition.

The continuation of fever for more than twenty-four hours after the onset of paralysis did not always presage an increase in paralysis.

If paralysis continued to spread after twenty-four hours,/

hours, the prognosis was grave.

Sphincter disturbance was not always associated with involvement of the pyramidal tract.

When there was still fever at the time a patient required artificial respiration, the outlook was hopeless.

Penicillin, given by a combination of the intrathecal and intramuscular routes at the earliest stage at which the disease could be diagnosed, was probably of no value, but the small number of cases to whom it was given must be borne in mind. The dosage by the intramuscular route was the standard one employed in the Army, which is effective against penicillin - sensitive organisms.

The intrathecal injection of sodium penicillin, in a strength of 500 Oxford units per cubic centimetre of sterile normal saline, had an irritant effect on the meninges in two out of twelve cases of acute anterior poliomyelitis.

SUMMARY.

Sixteen cases of acute anterior poliomyelitis in young fit adults are described.

The differential diagnosis is discussed, taking into consideration cases of other diseases whom I have had under my care.

The relative value of various symptoms and signs is discussed.

Conclusions are drawn as to the value of signs with regard to immediate prognosis.

The use of penicillin in the treatment of twelve cases is described.

In these cases, penicillin was of no value.

Sodium penicillin, when injected intrathecally, was not devoid of irritant effects.

REFERENCES.

Army Notes on Nervous Diseases and Head Injuries in the Middle East. Second Edition 1943. General Headquarters, Middle East Forces.

Brain, W. Russell. Diseases of the Central Nervous System, London 1942.

who quotes:- Faber (1933) Acute poliomyelitis as a primary disease of the Nervous System. Medicine XII. 83.

Flexner S. (1938) Epidemic poliomyelitis. Brit. Med. Journ. I. 468.

Guillain G. and Barré J.A. and Strohl A. (1916) sur un syndrome de radiculo-neurite avec hyperalbuminose du liquide céphalo-rachidien sans réaction cellulaire. Remarques sur les caractères cliniques et graphiques des réflexes tendineux. Bull. et mém. Soc. méd. d. hôp. de Paris XL 1462.

Schultz E.W. and Gebhardt L.P. (1933). Observations on the intranasal route of infections in experimental poliomyelitis. Proc. Soc. Exp. Biol. XXX, 1010.

Wells M.W. (1932) "Poliomyelitis" (International Committee for the Study of Poliomyelitis, Baltimore) p.444.

Lancet (1942) A leading article I, 741.

quoting:- Armstrong. Harvey Lecture 1940-41, p.39.

Armstrong/

Armstrong and Hornibrook. Public Health Report. Washington 1941. 56, 907.

Farmer and Janeway "Medicine" 1942. 21, pp.1-8.

Manson's Tropical Diseases. 11th Edition 1942. Edited by Sir P.H. Manson-Bahr.

Petto, Heinrich. Die Akut entzündlichen erkrankenungen der Nerven system. Edited by Georg Thieme. Leipsig 1942. (I borrowed this book from the library of a University in Sicily.)

Price, Frederick W. Textbook of the Practice of Medicine. 4th Edition, London, 1934.